

# TALLER DE NEUROIMAGEN



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# OBJETIVOS

- ⌘ **Definir el rol que tienen la RM y TC en la evaluación de la patología intracraneal**
- ⌘ **Determinar el abodaje diagnóstico por imagen de manera sindromática en cefalea y crisis convulsivas.**
- ⌘ **Ventajas y desventajas de cada uno de los métodos.**

# METODOS DE IMAGEN



RM



ASD



TC



US



MN



# ABORDAJE DIAGNÓSTICO

- ⌘ **Sintomatología**
- ⌘ **Edad del paciente**
- ⌘ **Cronicidad de los síntomas**



# SINTOMATOLOGIA

## ⌘ CEFALEA

- ⌘ Síntoma no convulsivo mas frecuentemente referido para estudio de imagen.



# CEFALEA

⌘ La modalidad de imagen depende de la evolución y características

⌘ AGUDA-----TC

⌘ CRONICA-----RM



# CEFALEA

## ⌘ Lesiones vasculares

- ⌘ Aneurismas

- ⌘ Malformaciones arterio-venosas

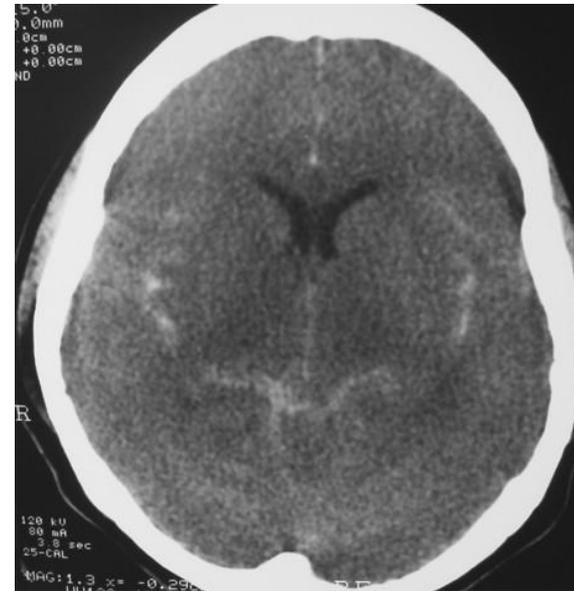
- ⌘ Trombosis venosa

## ⌘ Neoplasias

- ⌘ Hidrocefalia

## ⌘ Otras

# HEMORRAGIA SUBARACNOIDEA



**TC: Hiperdensidad en espacio subaracnoideo.  
La TC sigue siendo el estudio de elección en la  
hemorragia subaracnoidea aguda.**



# Hemorragia subaracnoidea

- ⌘ En etapa aguda es difícil detectar por RM
- ⌘ T1
  - ⌘ Sangre y LCR mezclados dan apariencia “sucia”
- ⌘ T2
  - ⌘ Discretamente hiperintensa al LCR y parénquima
- ⌘ **TC es el método de elección en etapa aguda.**



# Hemorragia subaracnoidea

- ⌘ La RM es muy superior en detectar HSA en etapa subaguda o crónica.
- ⌘ T1 y T2
  - ⌘ Hiperintensa
- ⌘ Etapa crónica:
  - ⌘ Depósito de hemosiderina



# Foto hemorragia partida



# MALFORMACIONES VASCULARES

- ⌘ **Aneurismas**
- ⌘ **Malformación Arterio-Venosa**
- ⌘ **Angiomas cavernosos**
- ⌘ **Telangiectasias capilares**
- ⌘ **Malformaciones venosas (angiomas)**



# MALFORMACIONES VASCULARES

## ⌘ Vasos anormales

⌘ flujo

⌘ trombosis

## ⌘ Hemorragia

⌘ Estadios

## ⌘ Cambios secundarios encefálicos

⌘ isquemia por robo



# ANEURISMAS

## ⌘ Etiología

- ⌘ Congénitos
- ⌘ Ateroscleróticos
- ⌘ Traumáticos
- ⌘ Micóticos
- ⌘ Oncóticos

⌘ 5% en series de autopsias

## ⌘ Sintomático

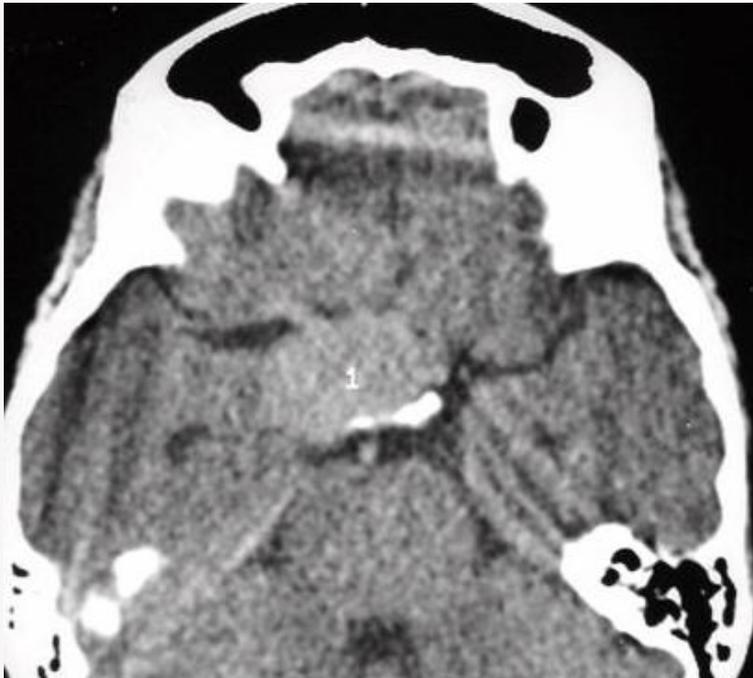
⌘ 40-60 años

## ⌘ Localización

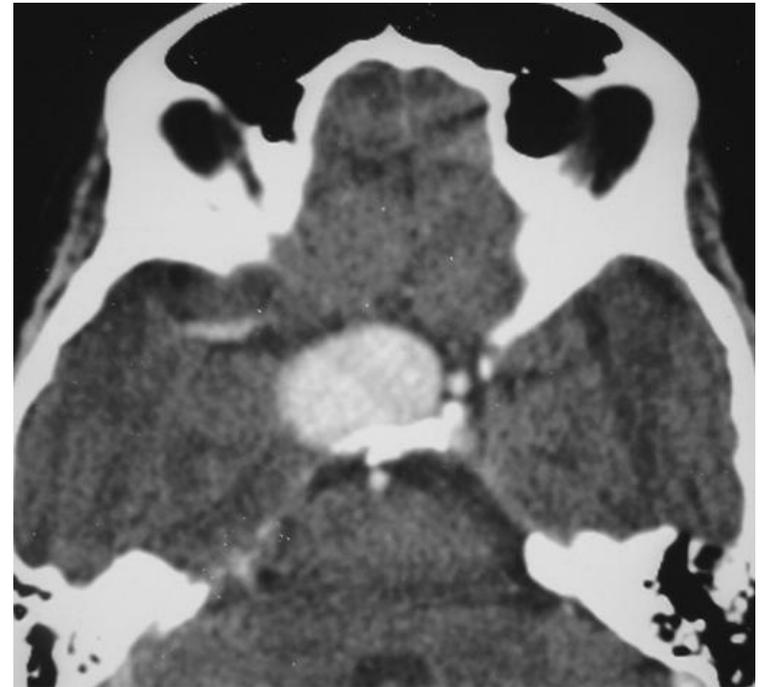
- ⌘ 33% ACoA
- ⌘ 33% ACI (ACoP)
- ⌘ 30% ACM (bifur.)
- ⌘ 5% Basilar
- ⌘ 5% Vasos de fosa posterior
- ⌘ 1-3% Otros

# ANEURISMA

TC



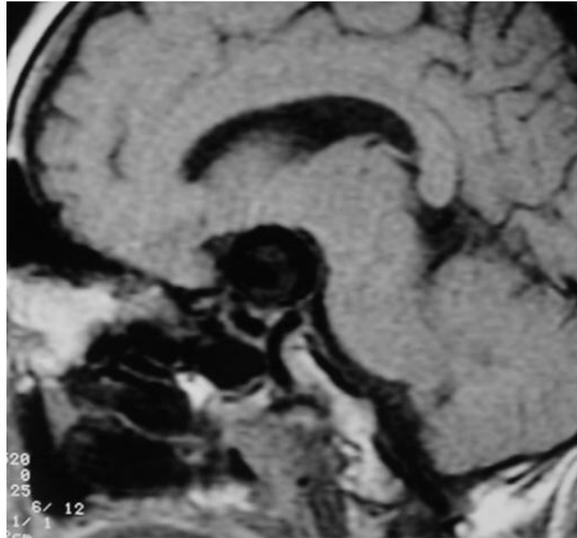
Simple



Cte iv

- Iso o hiperdensa
- Refuerzo intenso

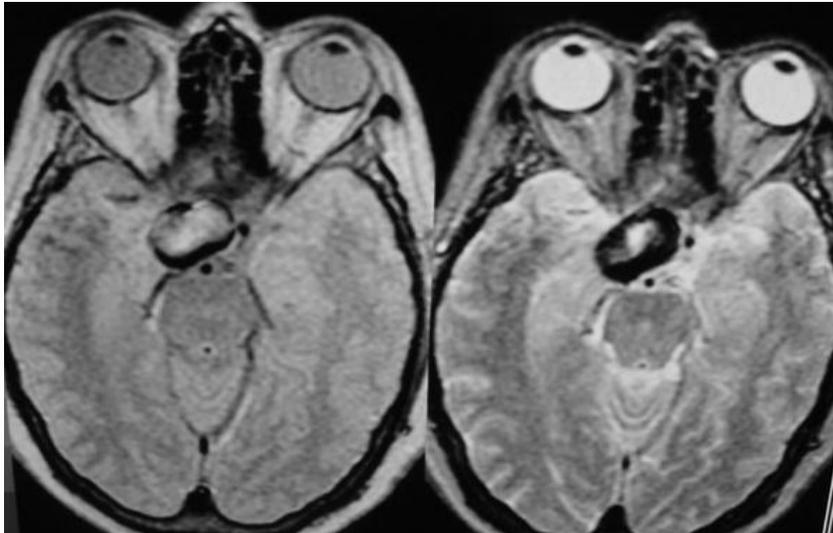
RM



T1



+Gd



T2

- Ausencia de señal T1 y T2
- Trombo-iso o hiper
- Artificio por pulsación
- Hemorragia o edema perianeurismático



# ANEURISMAS

## ⌘ Angiografía

⌘ Estándar de oro

## ⌘ RM

⌘ 3-4 mm de diámetro (5-6 mm)



# **MALFORMACIONES ARTERIOVENOSAS**

- ⌘ Malformación vascular sintomática más común.**
- ⌘ Parenquimatosas**
- ⌘ Congénitas**
- ⌘ Generalmente solitaria. 4% múltiples**
- ⌘ 20-40 años. 80% sintomáticas para los 50 años.**



# MAV

- ⌘ **70 – 90% Supratentoriales**
- ⌘ **No hay tejido normal entre la malformación**
- ⌘ **Tejido gliótico y atrófico asociado**
- ⌘ **Ca<sup>++</sup>**
- ⌘ **Aporte vascular pial o pial-dural**



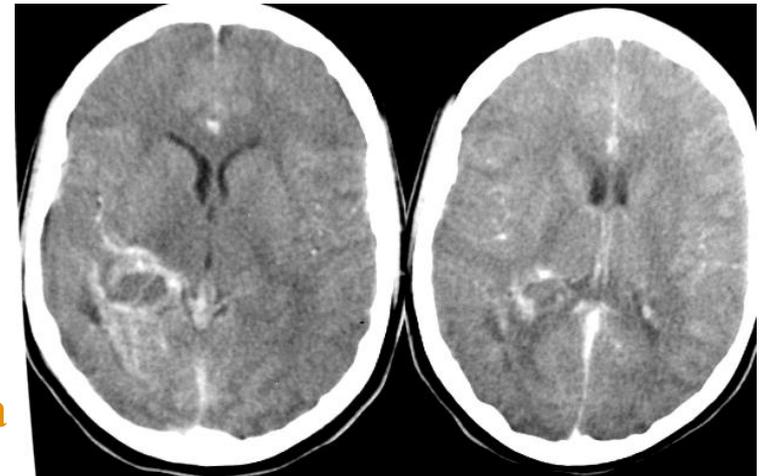
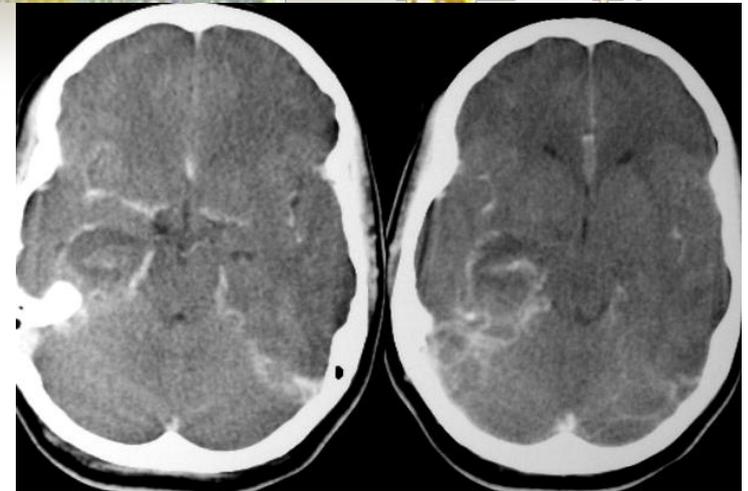
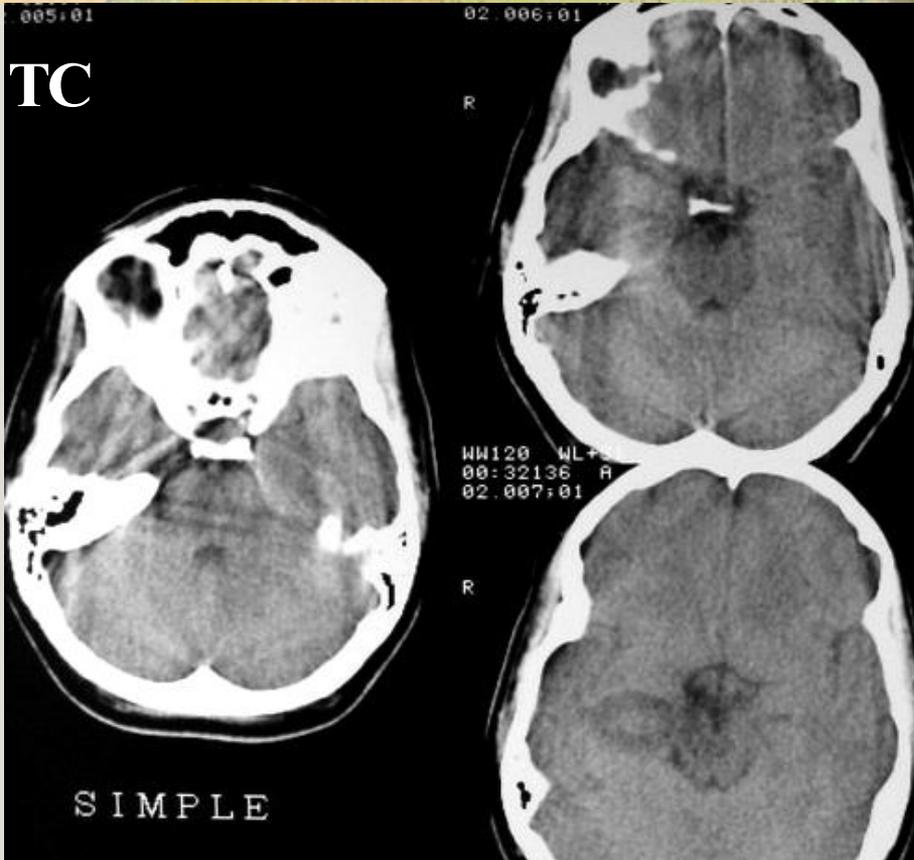
# MAV

## ⌘ SINTOMAS:

⌘ Cefalea, hemorragia subaracnoidea, convulsiones, déficit neurológico

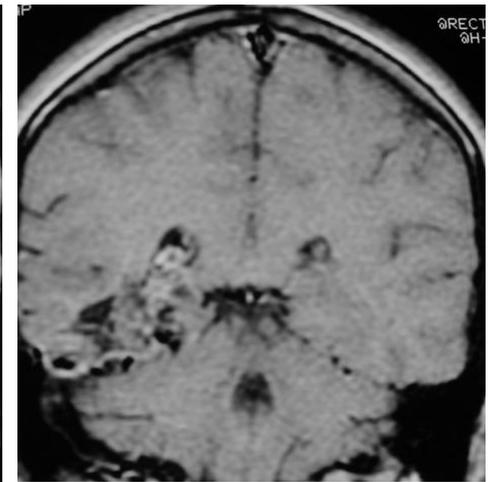
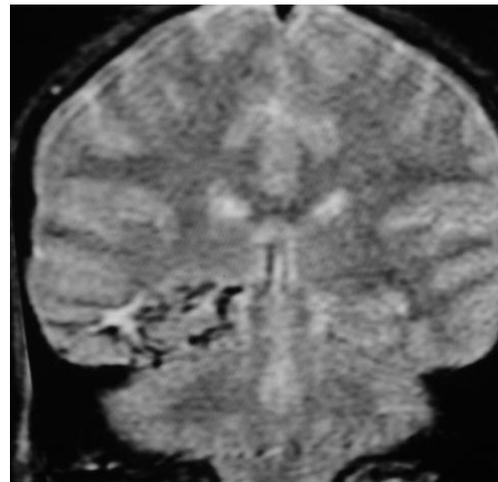
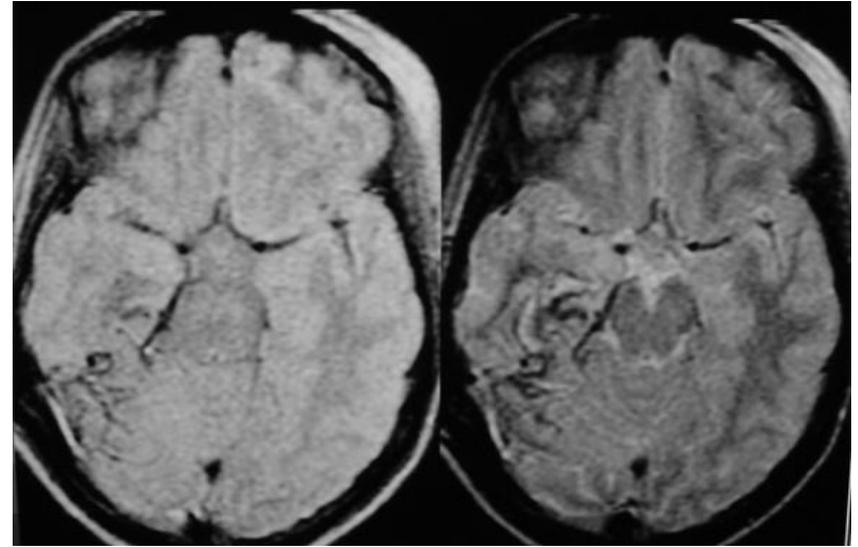
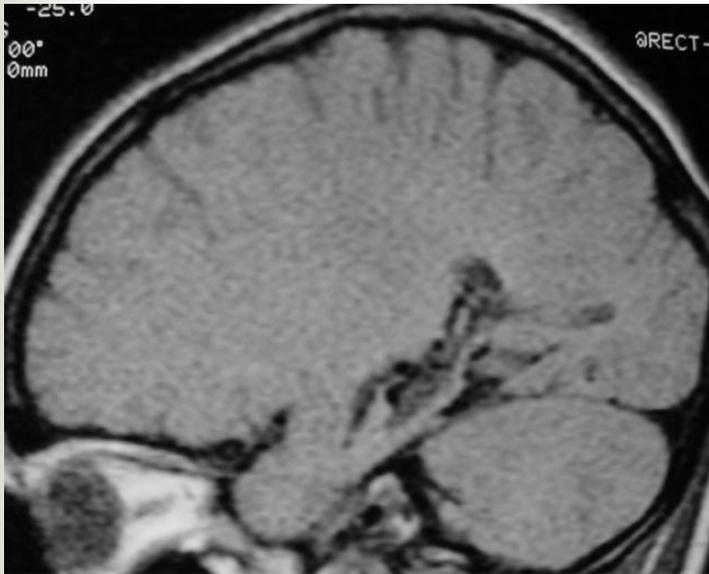
⌘ 2-3% anual riesgo de hemorragia

TC

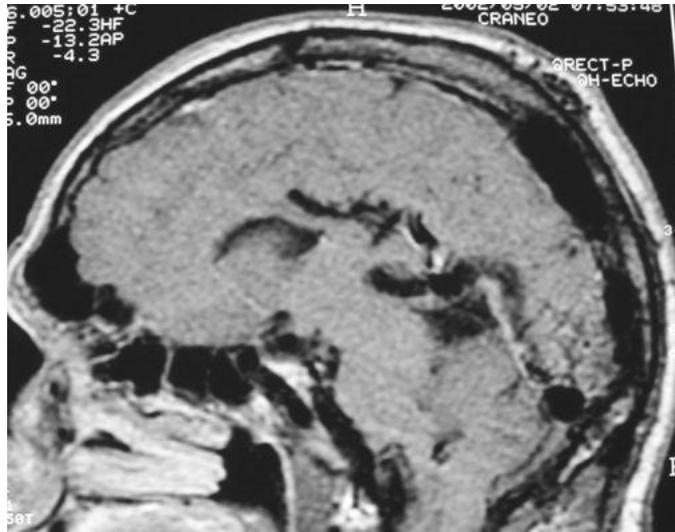


- Hemorragia, hematoma y atrofia asociada
- Imagen serpiginosa iso o hiperdensa
- Intenso refuerzo con cte iv
- $\text{Ca}^{++}$

# RM



RM

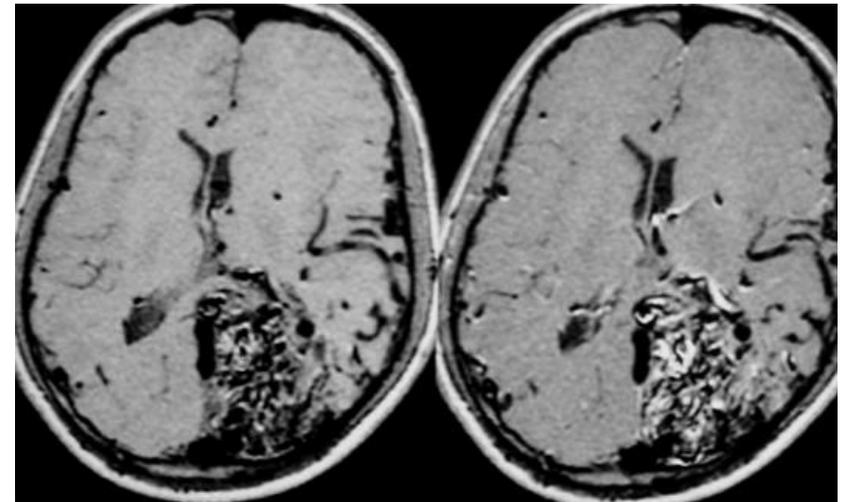
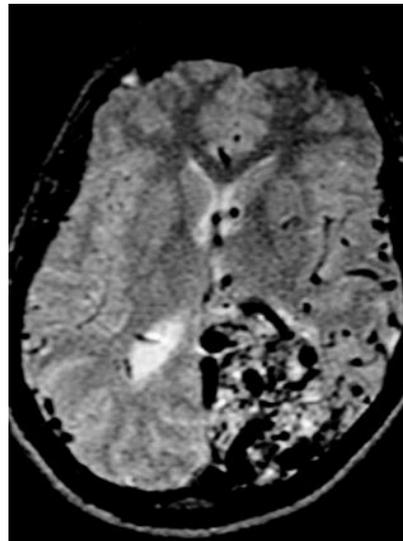


∞ Ausencia de señal por flujo

∞ Refuerzo relacionado al flujo

∞ Hiperintensidad en trombos y flujo lento

∞ Hemorragia en evolución



Masc. 44 años

# MAV

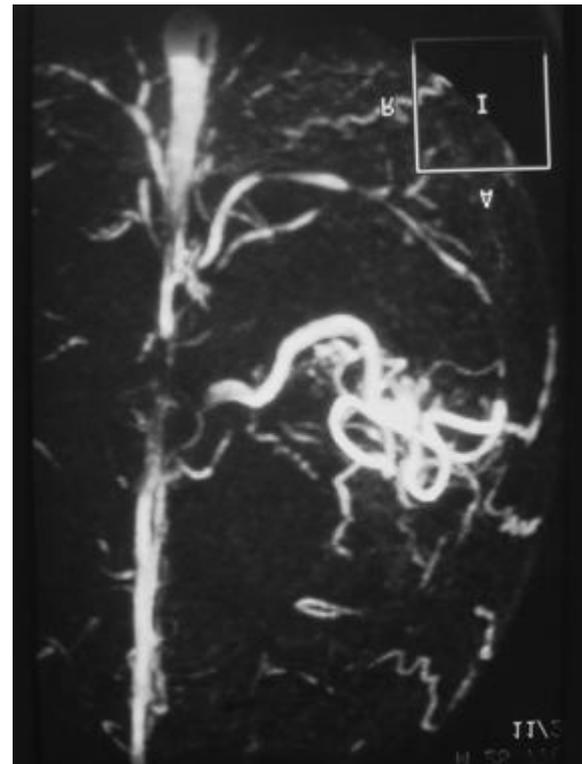
## Cambios asociados



- Isquemia por robo
- Atrofia
- Gliosis
- Hemorragia
- Edema

# Malformación arterio venosa cervical







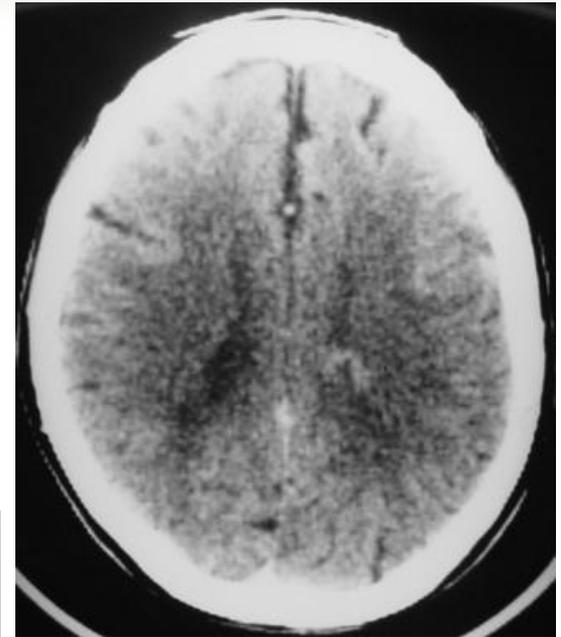
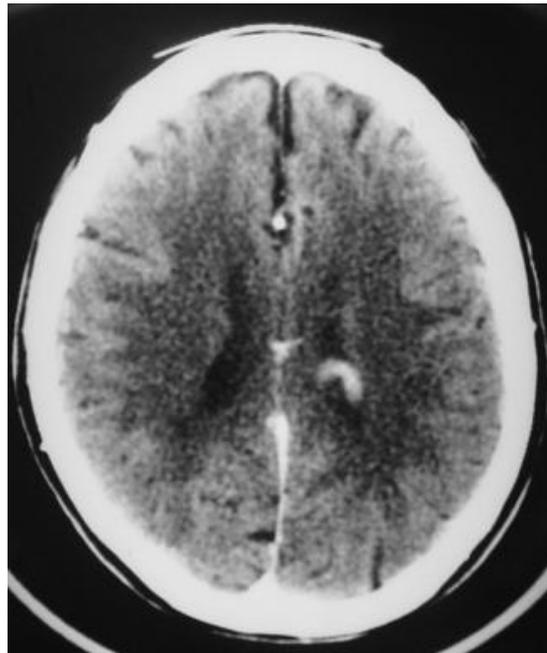
# **MAFORMACIONES VENOSAS**

- ❧ Malformación vascular incidental en autopsia (2%)**
- ❧ Sitio: cerebelares, sustancia blanca profunda cerebral**
- ❧ Patología: Arterias normales. Venas medulares dilatadas. Puede ser anomalía venosa del desarrollo.**
- ❧ Tejido cerebral normal entre los vasos.**
- ❧ Sintomas: cefalea, raro hemorragia. Hallazgo incidental.**

# Angioma venoso

TC:

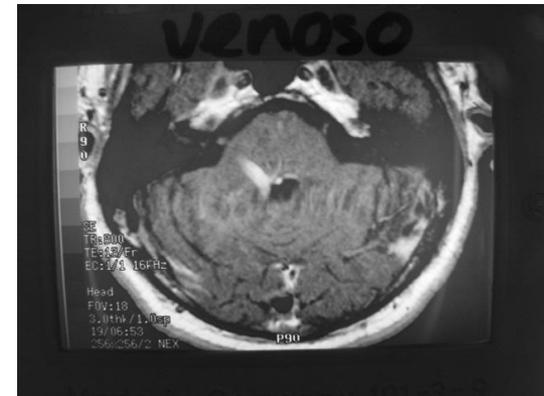
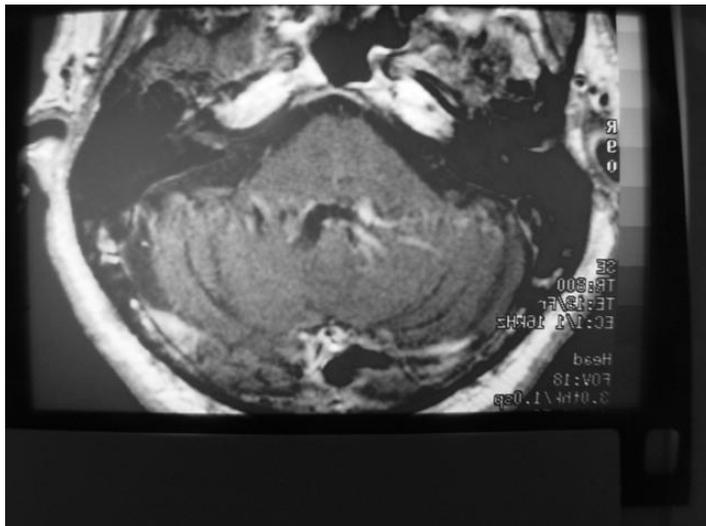
- Vasos drenando a una vena transcortical que drena a un seno venoso o a una vena subependimal



# Angioma venoso

## RM

- Estructura tubular sin señal
- Hiperintensidad paradógica por flujo lento
- Raramente gliosis o hemorragia





# ANGIOMAS CAVERNOSOS

- ⌘ **Malformación vascular más frecuentemente vista por RM.**
- ⌘ **Angiografía generalmente normal.**
- ⌘ **Cualquier localización**
- ⌘ **50% múltiples. Familiares en 80%.**
- ⌘ **20 – 40 años**
- ⌘ **Sintomas: 60% crisis convulsivas, 20-30% hemorragia, 20 – 25% déficit neurológico.**



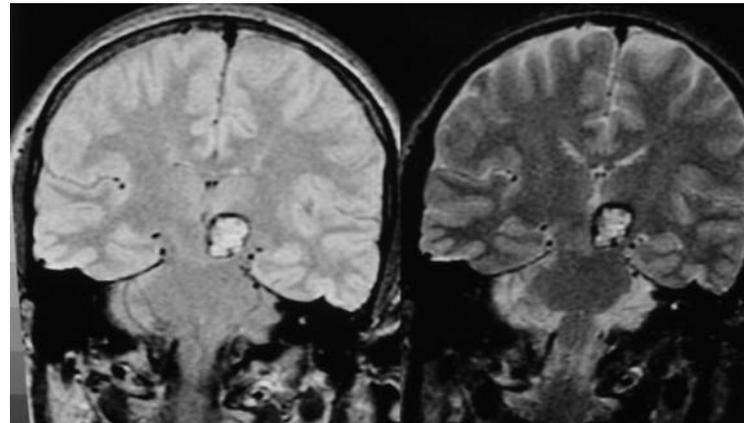
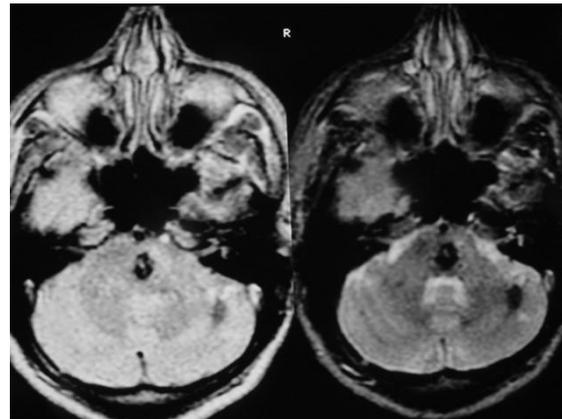
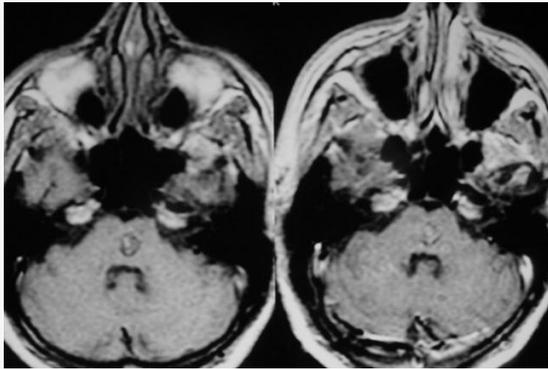
# Angiomas cavernosos

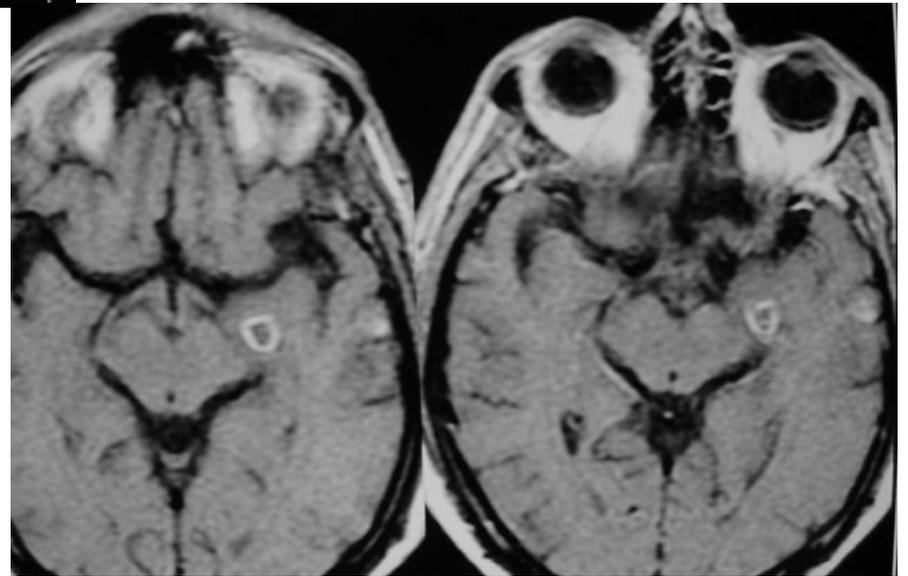
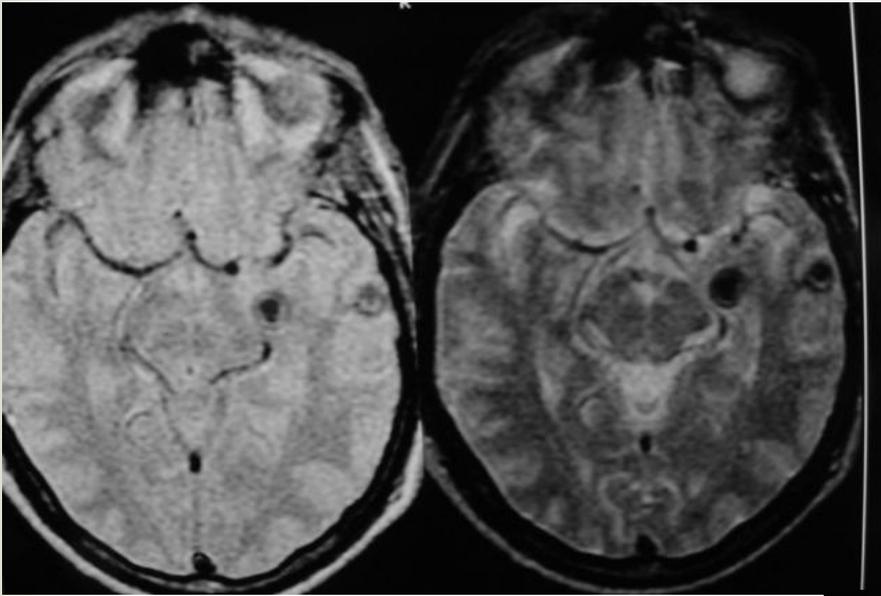
## ⌘ Patología

- ⌘ Espacios sinusoidales cubiertos de endotelio sin tejido neural. Hemorragia en diferentes estadios de evolución.
- ⌘ Riesgo de sangrado al exterior del mismo es del 0.1% anual. Sangrado oculto mas frecuente.

# Angioma cavernoso

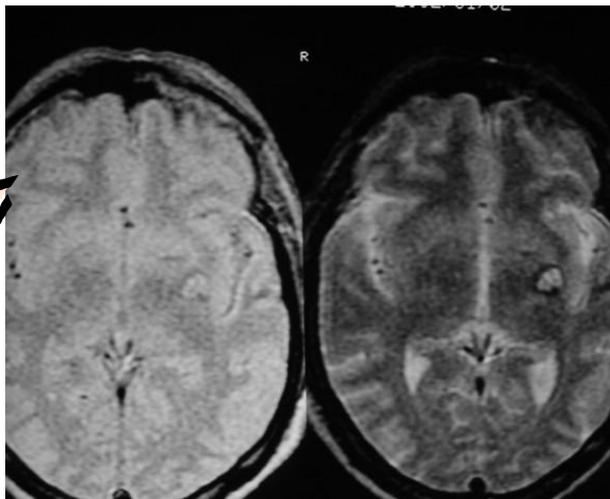
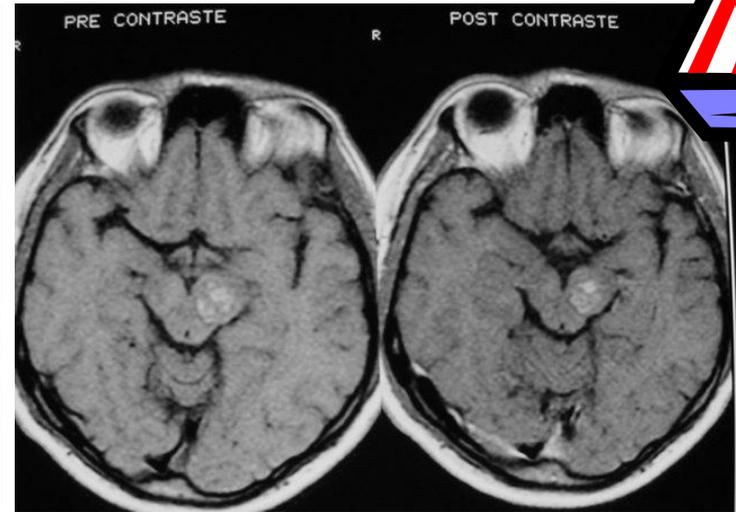
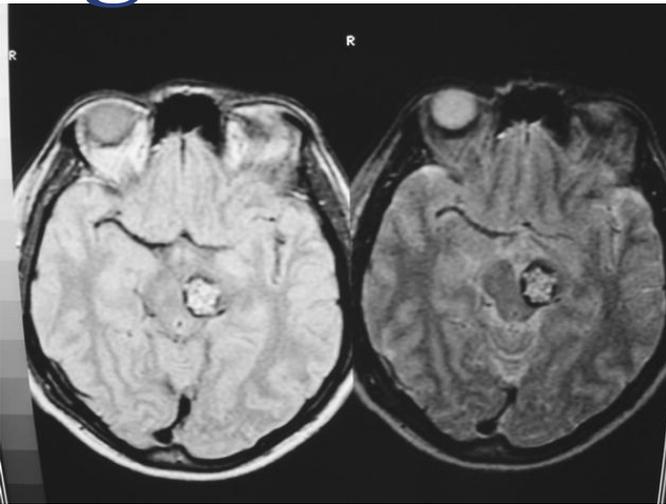
RM



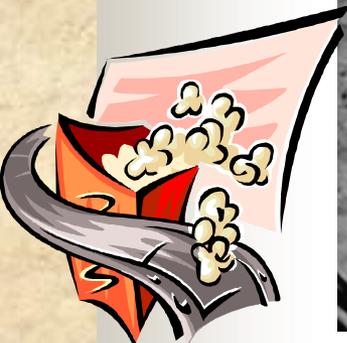


# Angioma cavernoso

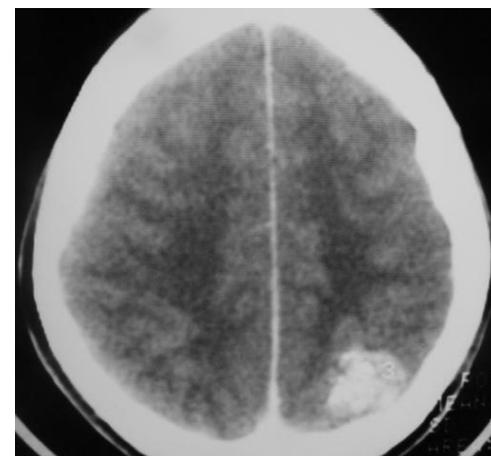
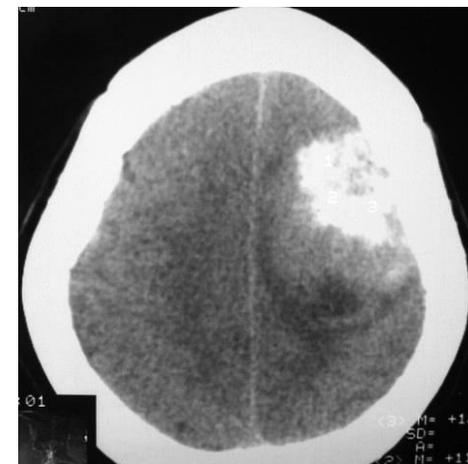
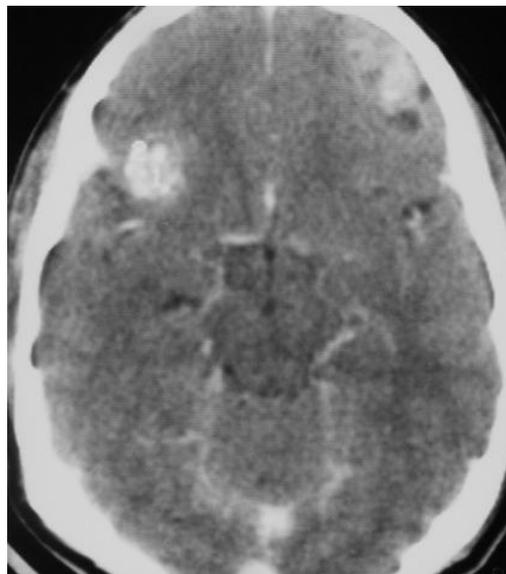
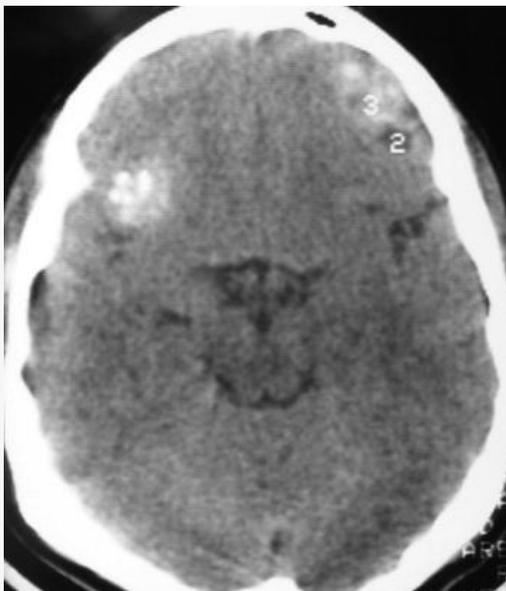
RM



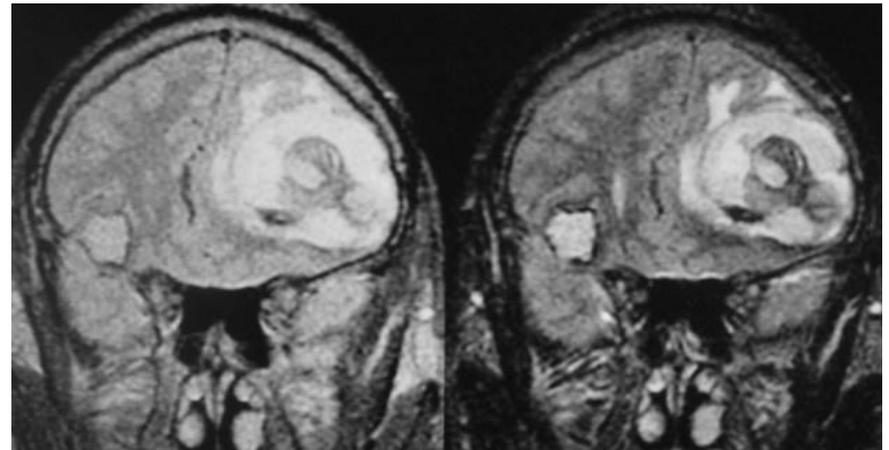
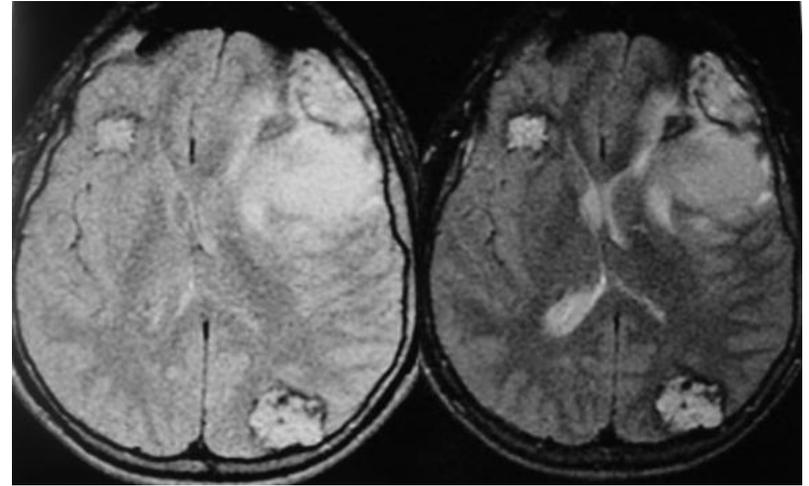
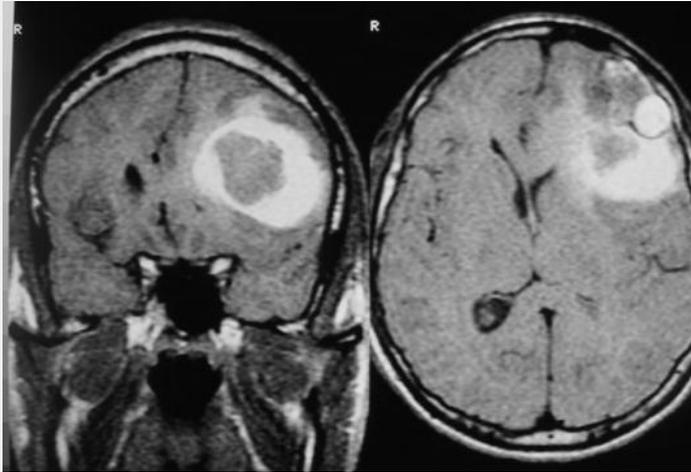
- Estructura interna compleja
- Diferentes estadios de sangrado
- Eco de gradiente: hipointensos por efecto de susceptibilidad magnética de la hemosiderina



# ANGIOMA CAVERNOSO



**Masc. 22 años**





# CRISIS CONVULSIVAS

- ⌘ **Crisis convulsivas es la causa más frecuente con que se refieren los pacientes para estudios de imagen.**
- ⌘ **Migraña es el condición no convulsiva más frecuente referida.**



**77 Las crisis convulsivas son solo un síntoma de una disfunción del SNC, y requiere de evaluación apropiada a fin de discriminar entre otras enfermedades no progresivas, enfermedades intracraneales progresivas y alteraciones idiopáticas.**



# CRISIS CONVULSIVAS

- ⌘ **Cambios estructurales**
  - ⌘ **Malformaciones congénitas**
- ⌘ **Procesos inflamatorios**
  - ⌘ **Meningitis, encefalitis.**
  - ⌘ **Neurocisticercosis**
- ⌘ **Malformaciones vasculares**
- ⌘ **Neoplasias**



# ABORDAJE DIAGNOSTICO

- ⌘ **Edad del paciente**
- ⌘ **Tipo de convulsión**
  - ⌘ **Focal**
  - ⌘ **Generalizada**
  - ⌘ **Patrón específico**
- ⌘ **Cronicidad**
- ⌘ **Síntomas asociados**



# PERIODO NEONATAL

- ⌘ **Alt. Metabólica (hipoglicemia, hipocalcemia, deficiencia de piridoxina, etc)**
- ⌘ **Asfixia perinatal (daño hipóxico isquémico)**
  - ⌘ **Hemorragia intracraneal**
- ⌘ **Malformaciones cerebrales**
- ⌘ **Infecciones del SNC (TORCH)**
- ⌘ **Manifestación inicial de errores del metabolismo**
- ⌘ **Trauma, fiebre, infección, etc.**
- ⌘ **Idiopática**



# **METODOS DE IMAGEN**

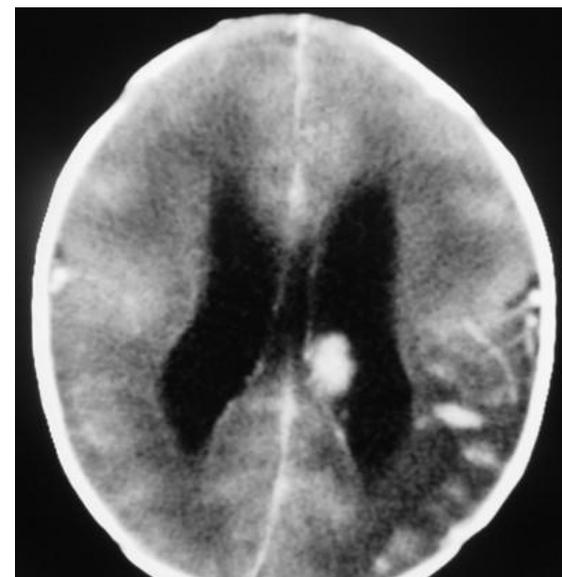
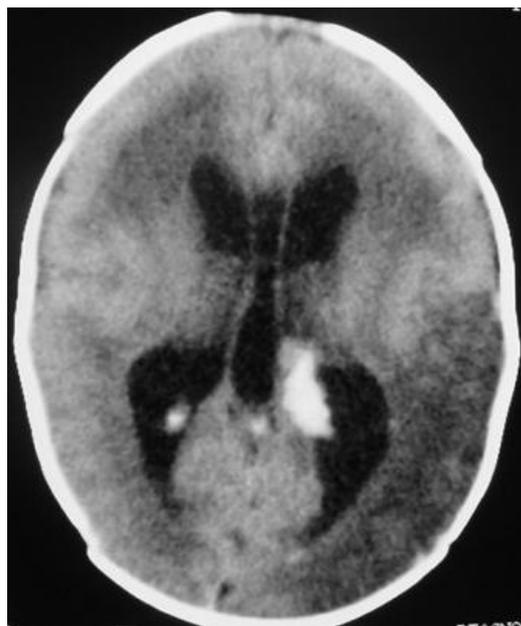
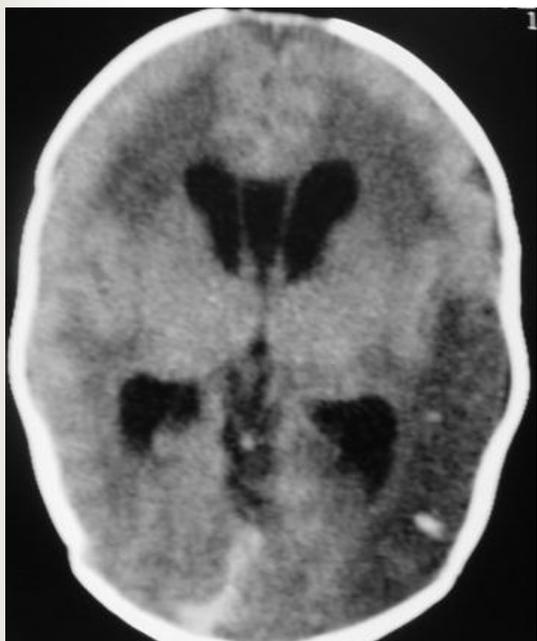
- ¶ US o TOMOGRAFIA COMPUTADA**
  - ¶ Neonato o lactante menor (convulsiones, espasmo infantil)**
  - ¶ Evaluación inicial**
    - ¶ Trauma neonatal**
    - ¶ Infección**
    - ¶ Malformación**
    - ¶ Encefalopatía hipóxico isquémica**



## ⌘ **RESONANCIA MAGNETICA**

- ⌘ **Epilepsia focal (simple o parcial) sin causa aparente demostrada clínica, US o por TC.**
- ⌘ **La RM ha mostrado tener mayor sensibilidad en detección de alteraciones del SNC.**

# SX HIPOXICO ISQUEMICO

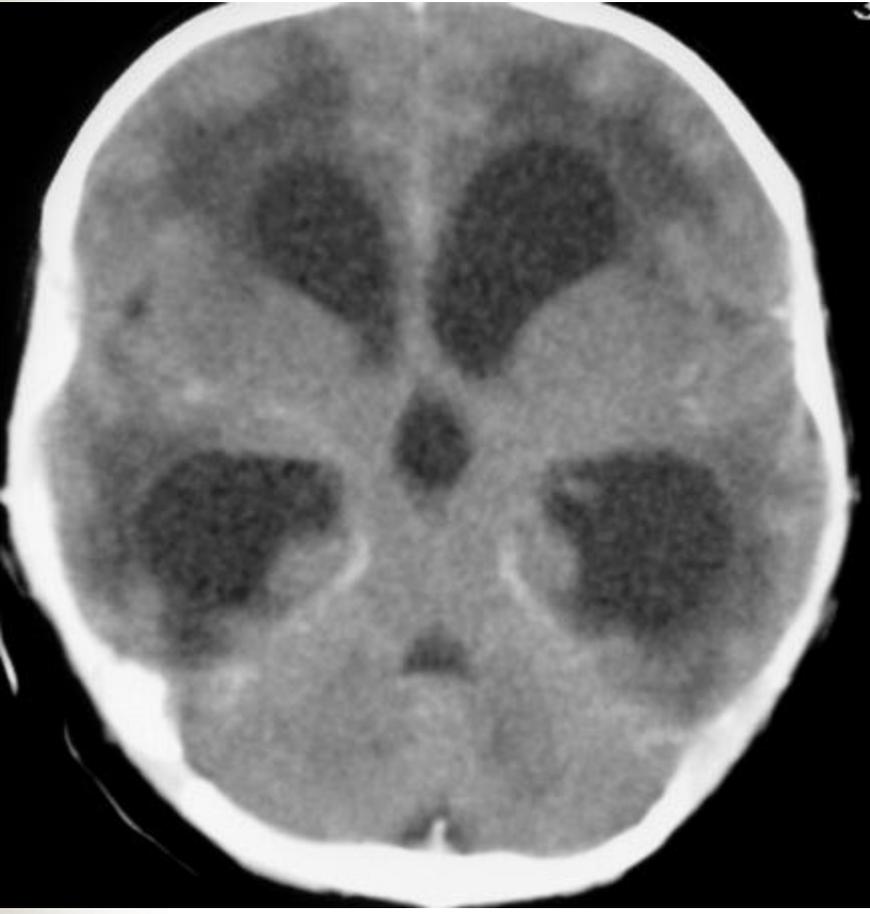


RN prematuro

# DAÑO HIPOXICO ISQUEMICO SEVERO



RN a término





# MALFORMACIONES CONGENITAS ESTRUCTURALES

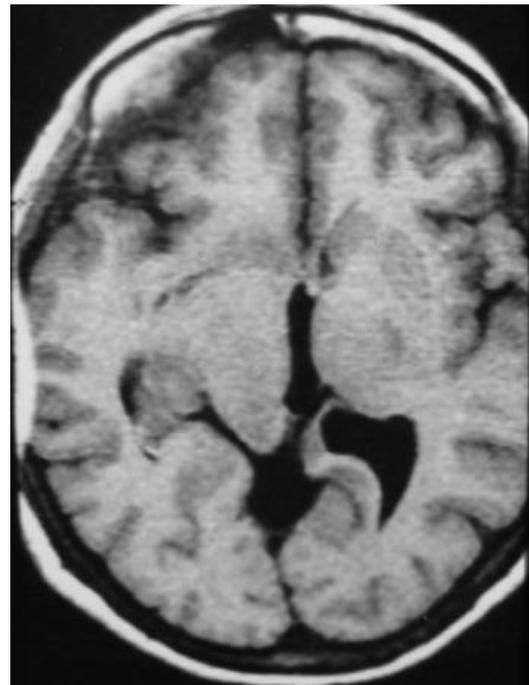
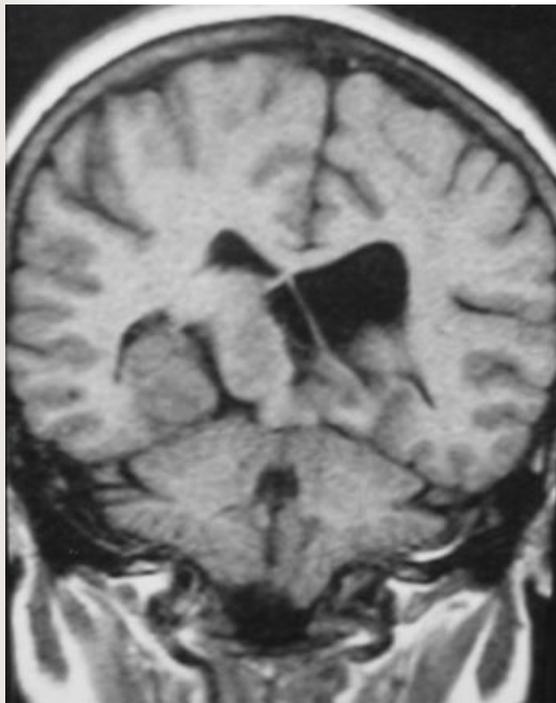
- ⌘ **Alteración en la organogénesis**
  - ⌘ Tubo neural
  - ⌘ Alt. En la sulcación y diverticulación
  - ⌘ Alt. En la migración neuronal
  - ⌘ Alt. En el tamaño
  - ⌘ Lesiones destructivas
    - ⌘ Hidranencefalia, porencefalia, infecciones inutero.
- ⌘ **Alteración en la histogénesis**
  - ⌘ Síndromes neurocutáneos



# Malformaciones congénitas

- ⌘ **Presentes en 1% de los nacimientos**
- ⌘ **Presentes en el 75% de las muertes fetales**
  - ⌘ **10% anomalías cromosómicas**
  - ⌘ **20% factores hereditarios**
  - ⌘ **10% ambiente intrauterino adverso (infección)**
  - ⌘ **60% sin causa identificable**
- ⌘ **Han sido descritas más de 2000 malformaciones congénitas del SNC**

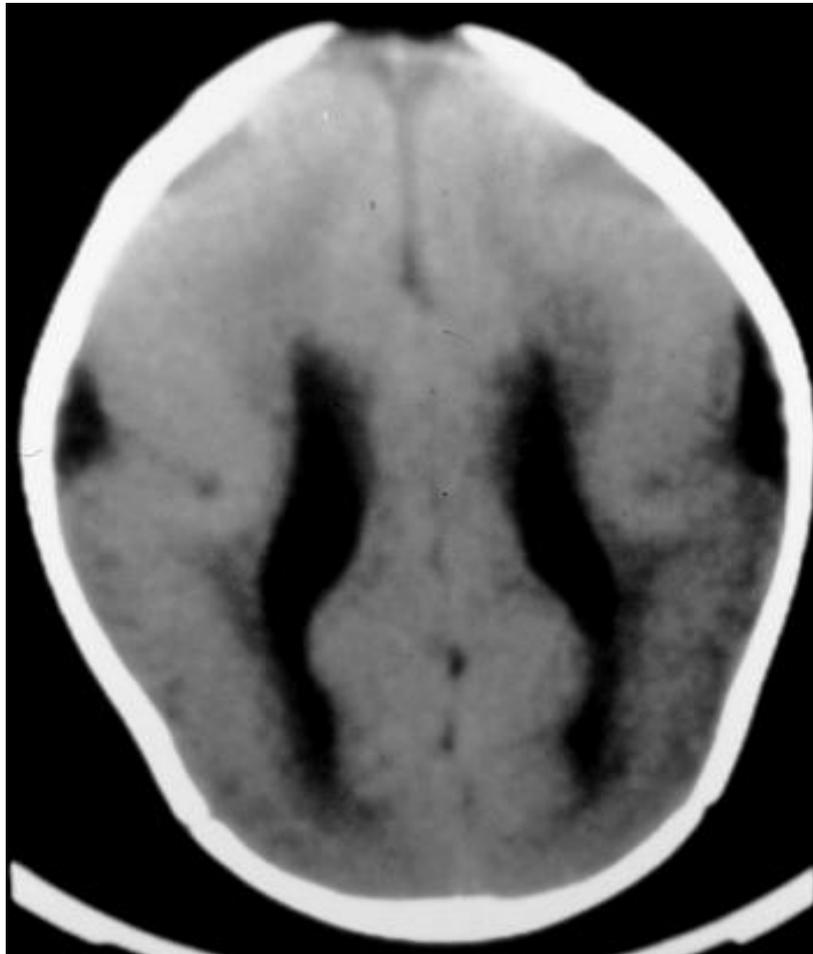
# ALT. EN LA ORGANOGENESIS



**Esquizoencefalia**

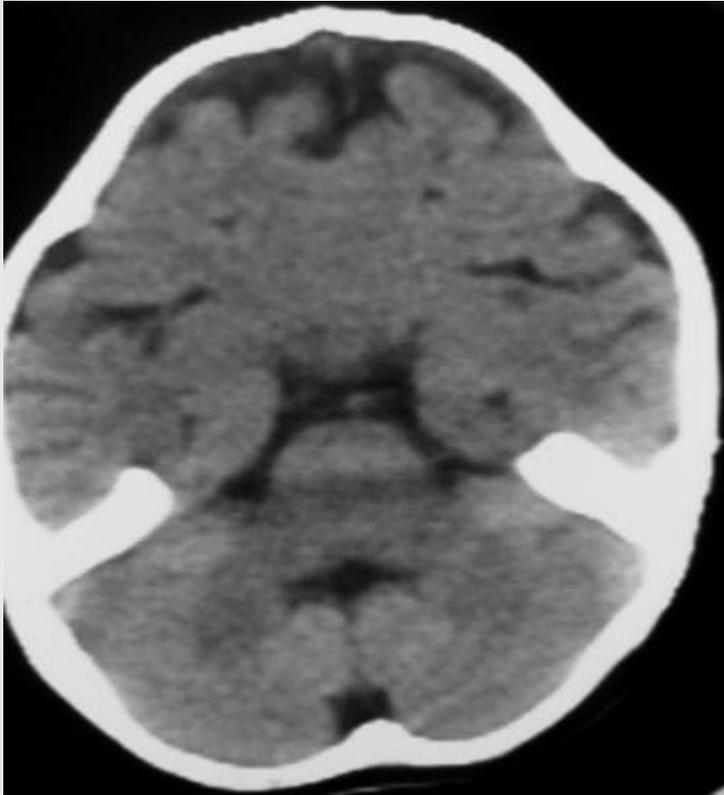
# ALT. EN SULCACION Y MIGRACION NEURONAL

**TC  
Simple**

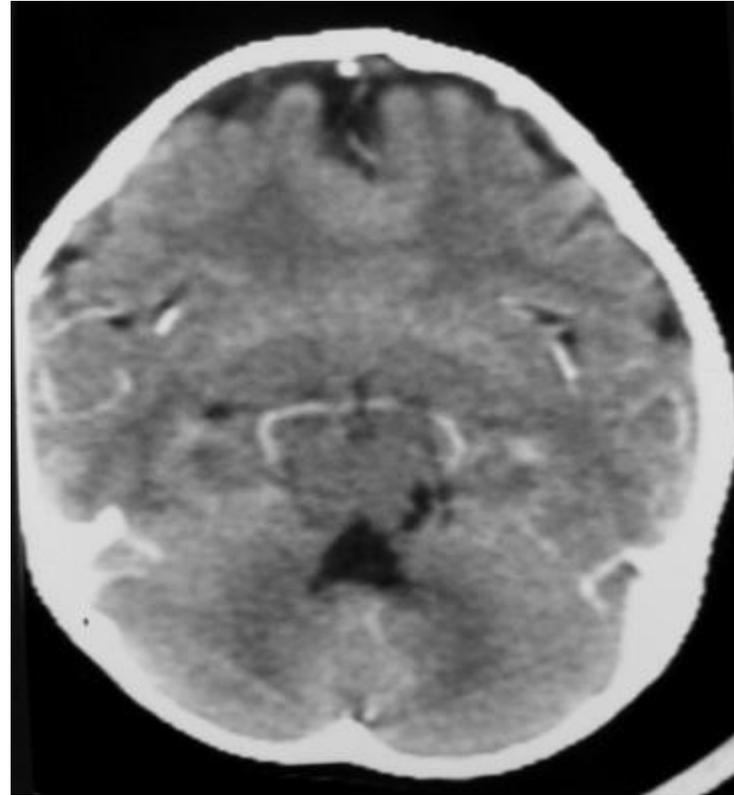


**Lisencefalia**

**TC simple**



**Cte i.v.**



**Holoprosencephalia semilobar**

**RM**  
**T1 coronal**



**Heterotopia de  
sustancia gris**



# LESIONES DESTRUCTIVAS

⌘ **HIDRANENCEFALIA**

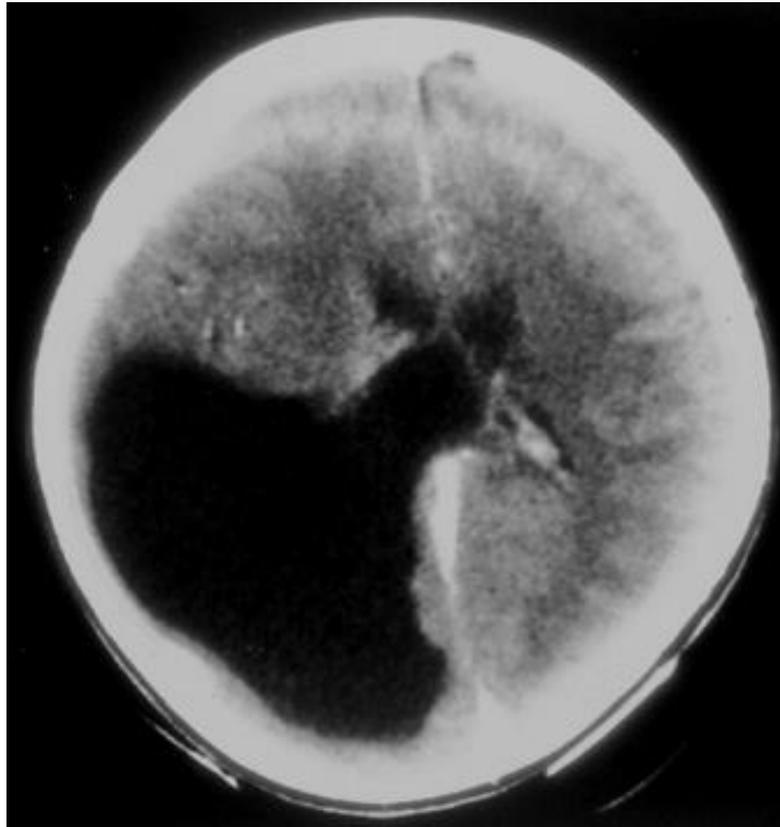
⌘ **PORENCEFALIA**

⌘ **INFLAMATORIAS**

⌘ **TORCH**

⌘ **Varía según el momento de la infección en relación al desarrollo fetal**

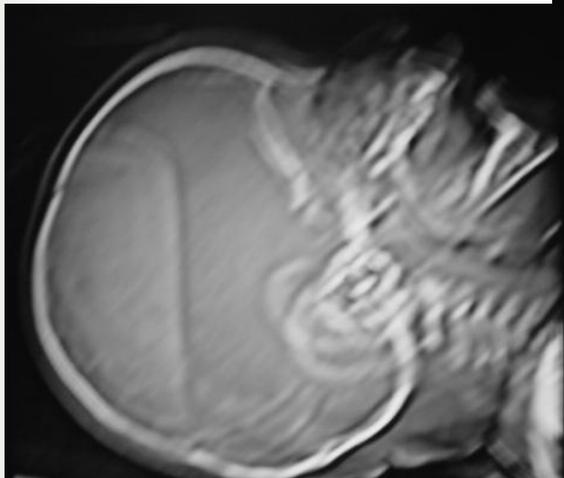
⌘ **HIPOXIA**



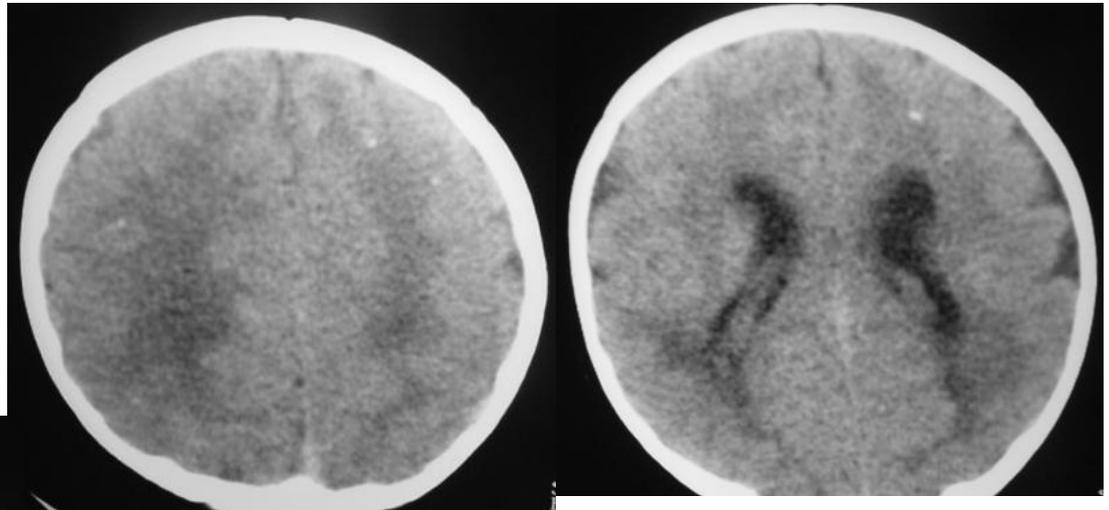
**Porencefalia**

# TORCH

Fem 10 meses



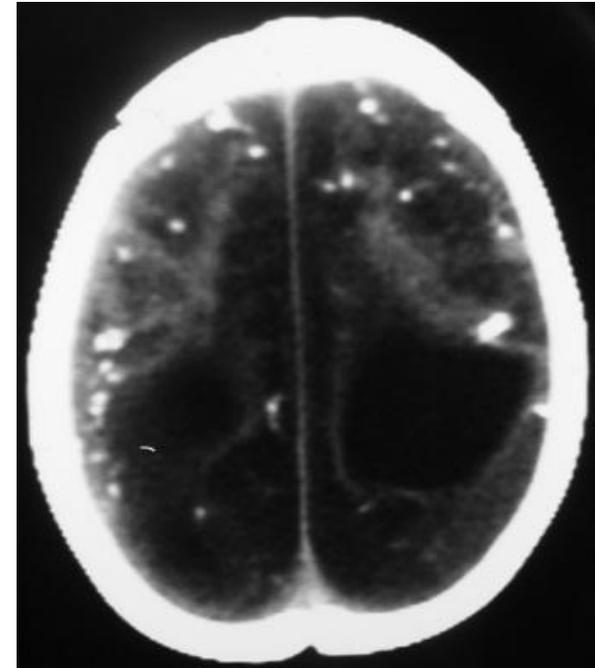
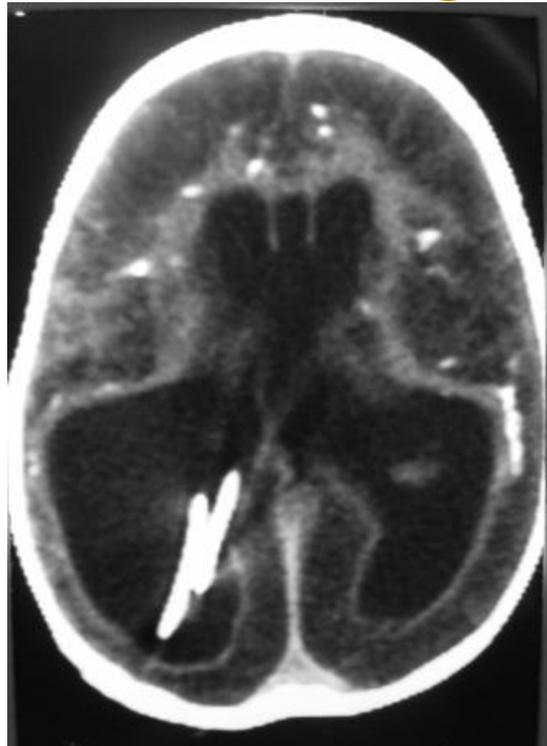
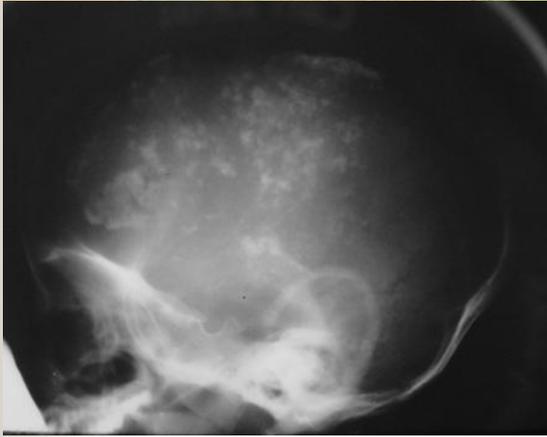
**Rubeola congénita**



- 3er trimestre
- Hidrocefalia
- Microcefalia
- Atrofia
- Microftalmia
- Calcificaciones

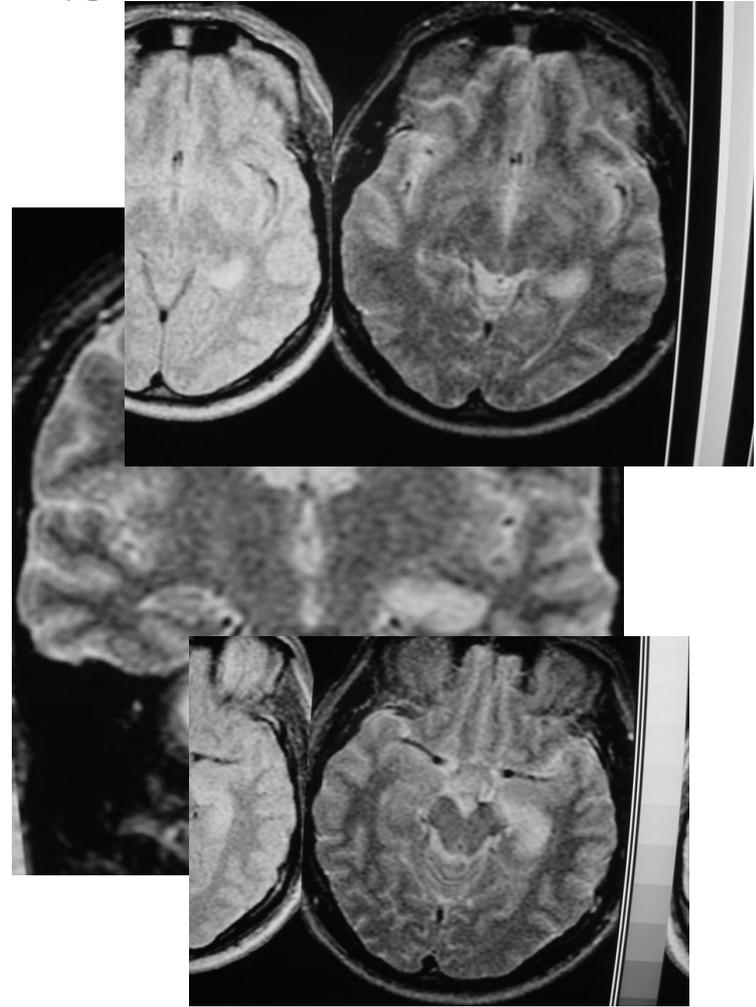
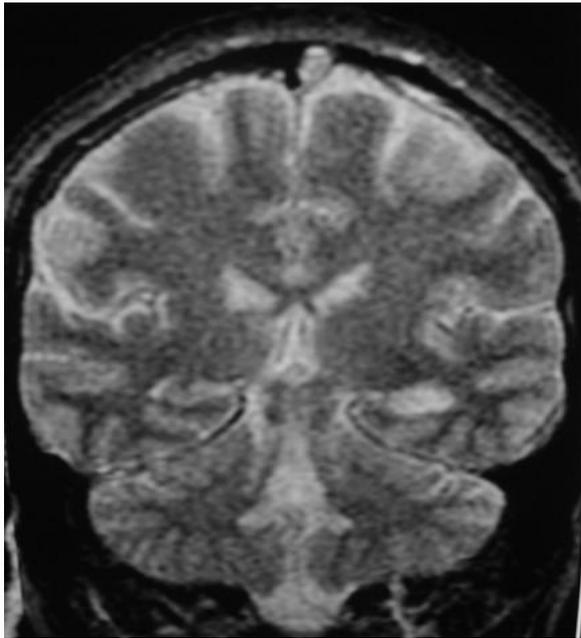
# Citomegalovirus

- Causa más frecuente de infección congénita del SNC
- Matriz germinal
- $\text{Ca}^{++}$  periventriculares
- Alt. Migración neuronal



TC

# ESCLEROSIS MIESIAL TEMPORAL





# PROCESOS INFLAMATORIOS

- ⌘ **Meningitis**
- ⌘ **Encefalitis**
- ⌘ **Neurocisticercosis**

# Enfermedades infecciosas en SNC

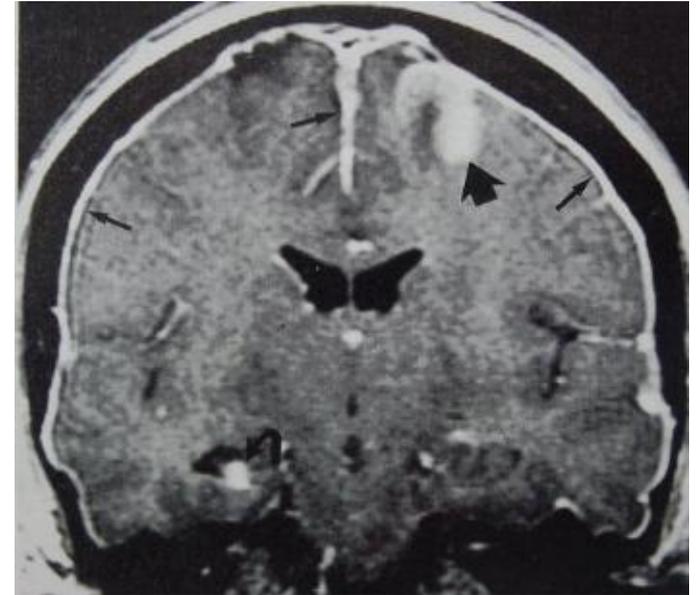
## ⌘ Meningitis

### ⌘ TC:

- ⌘ Normal
- ⌘ Edema

### ⌘ RM:

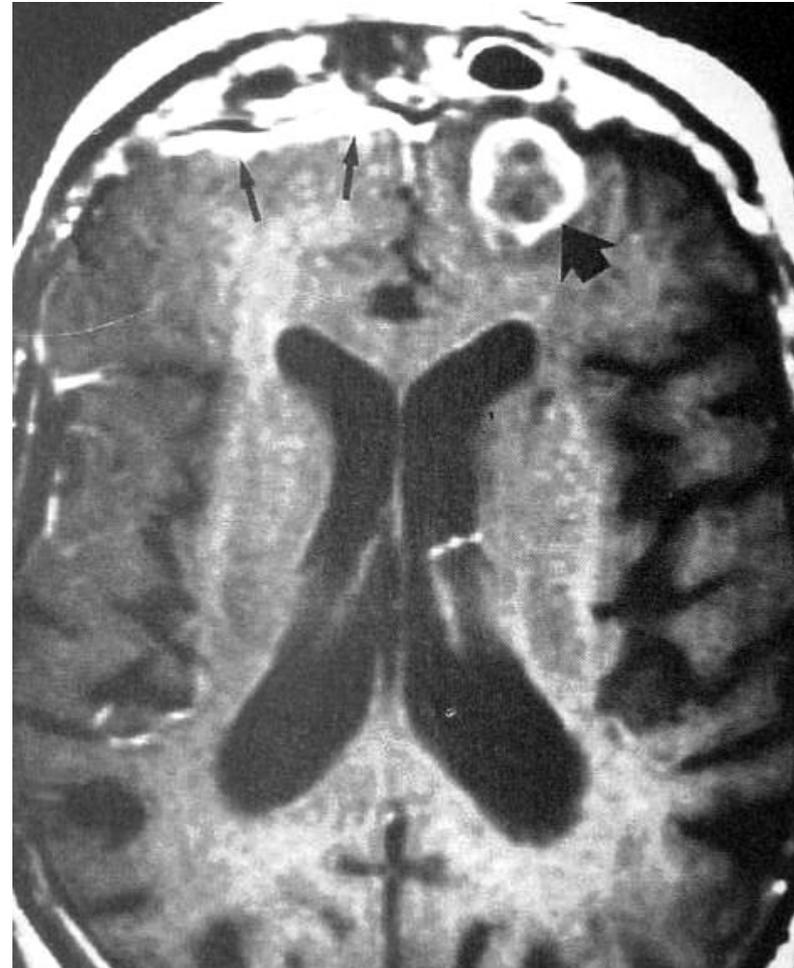
- ⌘ Gd. Refuerzo lineal continuo



**T1 post Gadolinio**

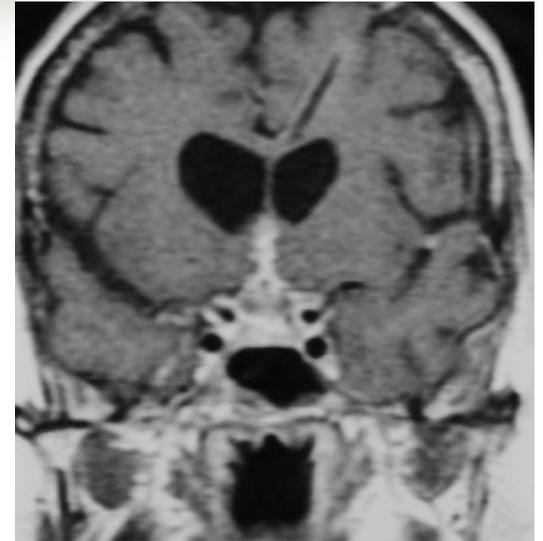
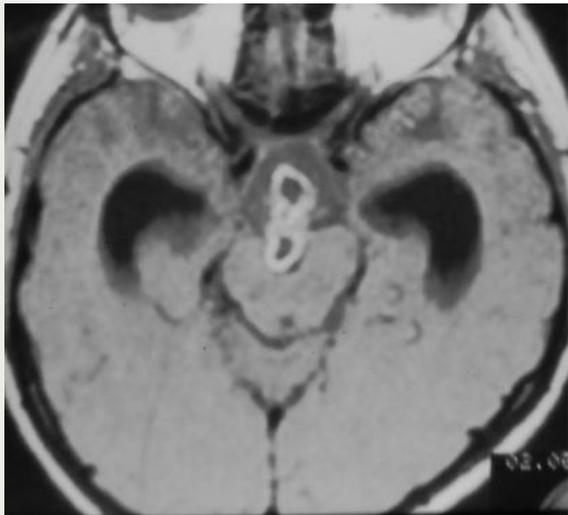
# COMPLICACIONES DE MENINGITIS

- ∅ Formación de abscesos
- ∅ Refuerzo anular
- ∅ Empiema
- ∅ Infartos

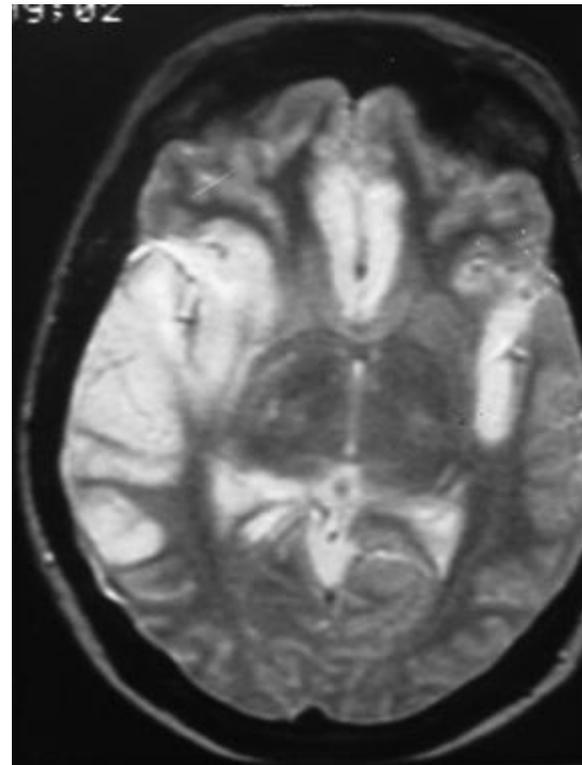
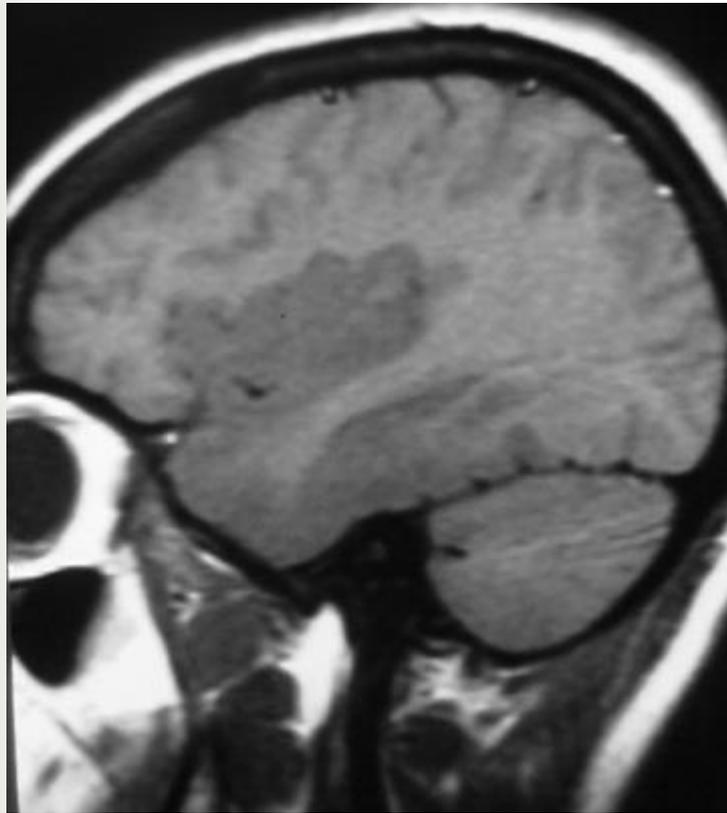


## • ENFERMEDAD GRANULOMATOSA

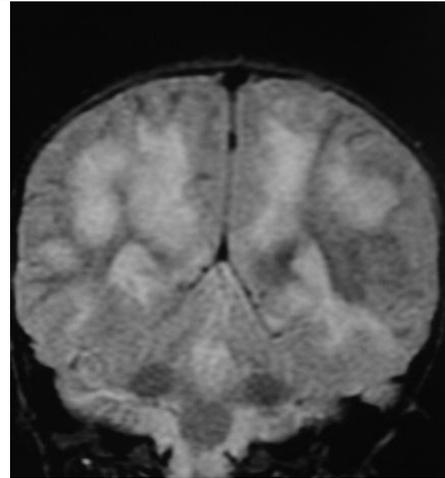
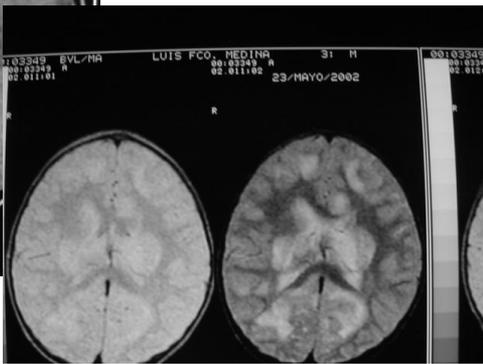
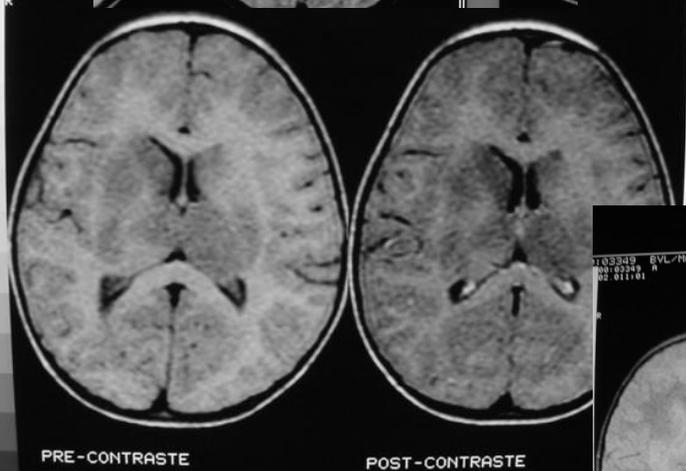
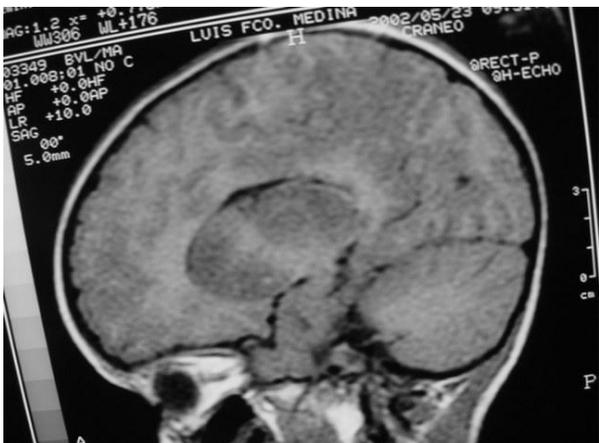
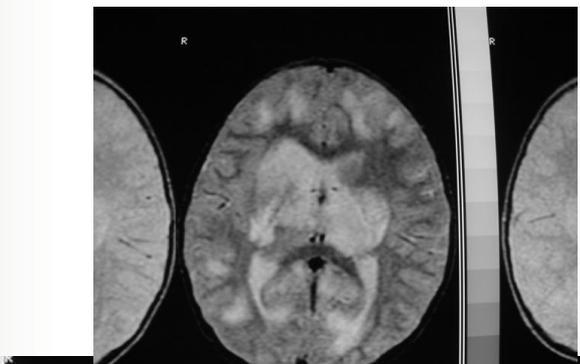
- Tb, toxoplasma, criptococo, etc.
- Lesiones múltiples nodulares o con refuerzo anular
- Edema perifocal y necrosis



# ENCEFALITIS



# Encefalitis viral

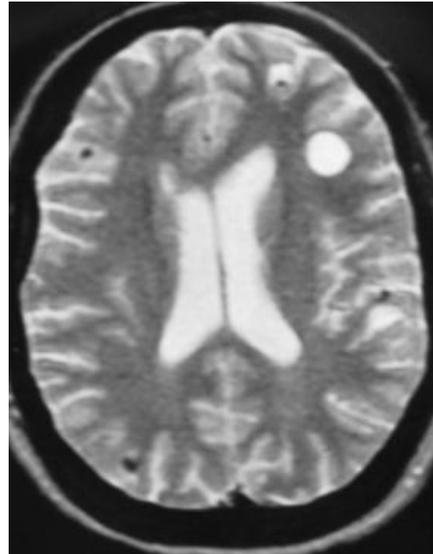


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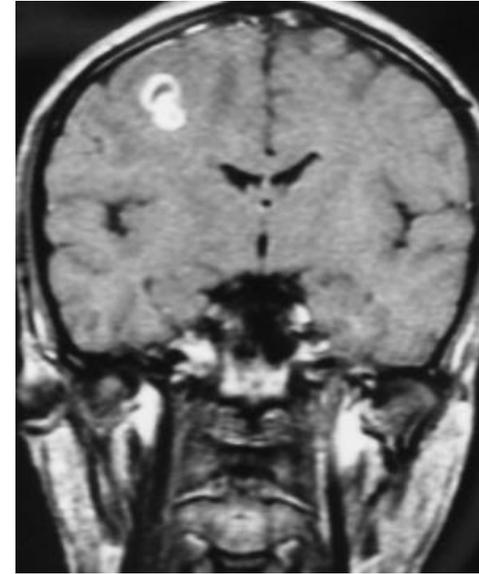
T1



T2



T1  
Gd



T1 Gd



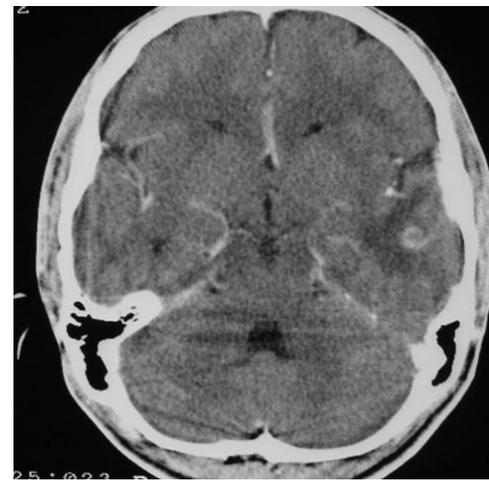
- Parenquimatosa
- Subaracnoidea

# NEUROCISTICERCOSIS

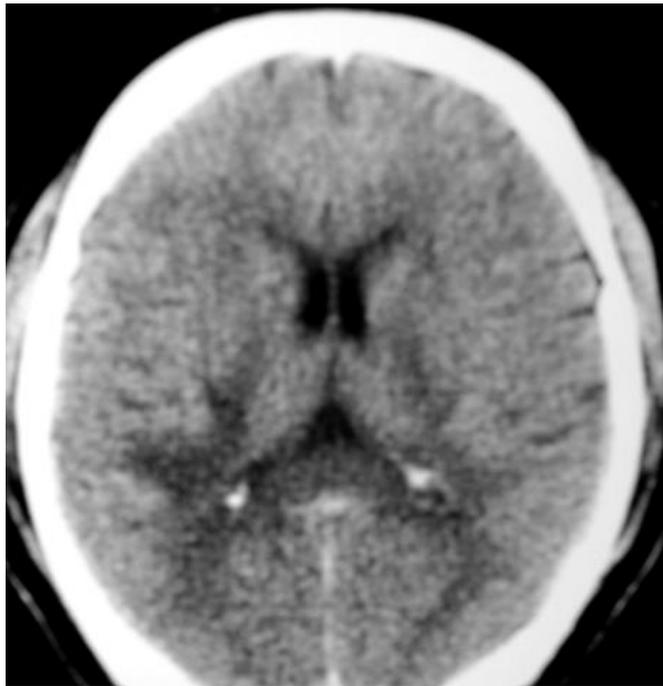
TC simple



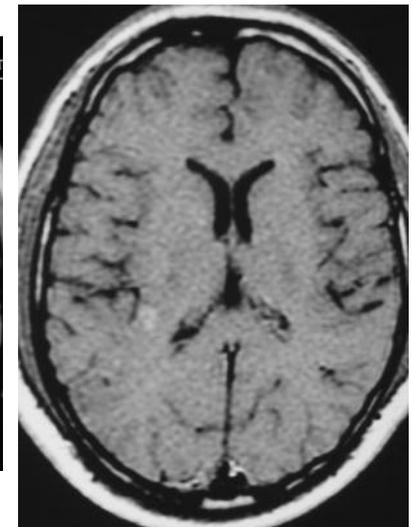
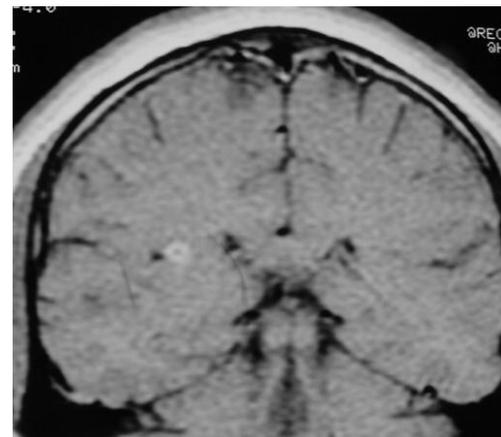
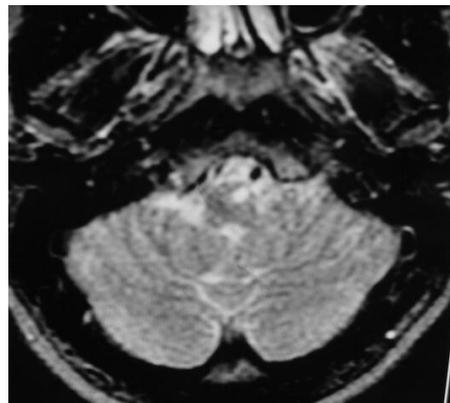
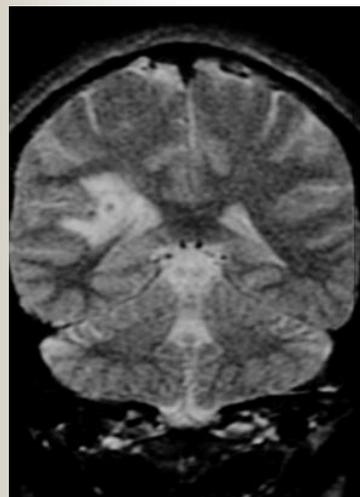
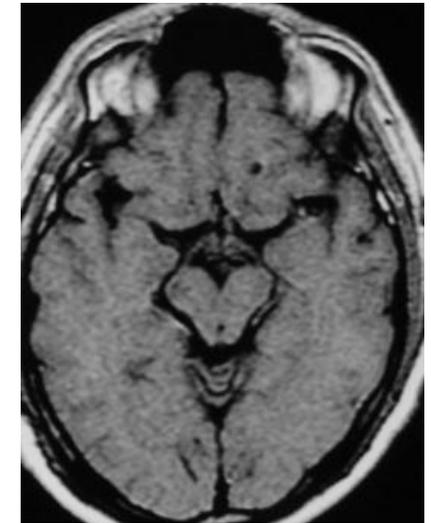
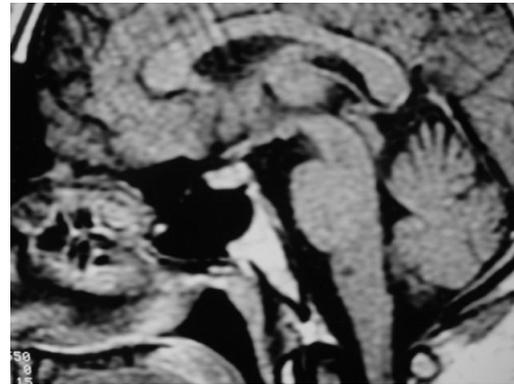
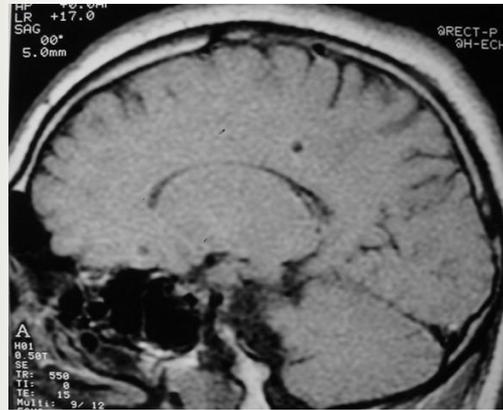
TC cte iv



# CRISIS CONVULSIVAS CISTICERCOSIS



# CRISIS CONVULSIVAS CISTICERCOSIS





# NEOPLASIAS INTRACRANEALES



# **ABORDAJE DIAGNOSTICO POR IMAGEN**

## **⌘ OBJETIVOS:**

- ⌘ Diferenciar origen intra o extracerebral**
- ⌘ Diferenciar una neoplasia de lesiones no neoplásicas**
- ⌘ Definir extirpe**
- ⌘ Estadiaje:**
  - ⌘ diseminación intracraneal**



# ABORDAJE DIAGNOSTICO POR IMAGEN EN NEOPLASIAS

- ⌘ Edad
- ⌘ Localización: intra o extraaxial
- ⌘ Unico o múltiple.
- ⌘ Tamaño.
- ⌘ Sólido o quístico



# ABORDAJE DIAGNOSTICO POR IMAGEN

- ⌘ Calcio, sangre, necrosis.
- ⌘ Edema adyacente
- ⌘ Efecto sobre sistema ventricular o línea media
- ⌘ Respuesta al medio de Contraste.



# **FACTORES QUE DETERMINAN LAS CARACTERISTICAS DE IMAGEN DE NEOPLASIAS INTRACRANEALES**

## **¶ H2O**

- ¶ compactación celular**
- ¶ agua intracelular**
- ¶ edema vasogenico o intersticial**

## **¶ Contenido proteico**

## **¶ Necrosis o quiste**

## **¶ Hemorragia**

## **¶ Calcio**

## **¶ Grasa**

## **¶ Estado de la barrera hemato encefálica**

## **¶ Borde o límite tumoral**

## **¶ Patrón de diseminación**



# Neoplasia primaria SNC

## ❧ TUMORES INTRAAXIALES SUPRATENTORIALES

- ❧ Gliomas

## ❧ TUMORES EXTRAAXIALES

- ❧ Meningiomas

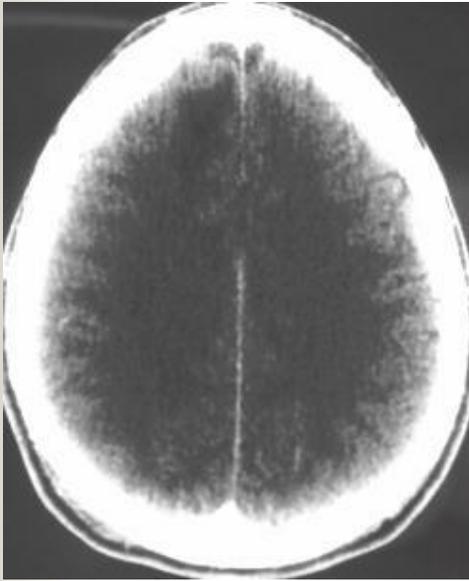
- ❧ Neuromas

- ❧ Hemangiopericitomas

- ❧ Tumores óseos

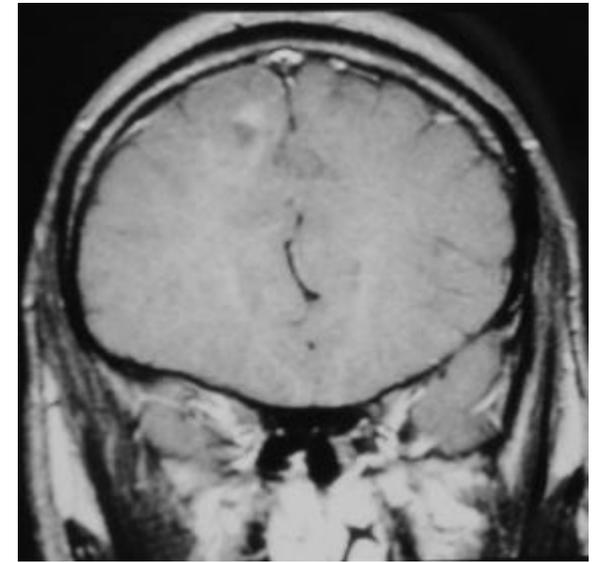
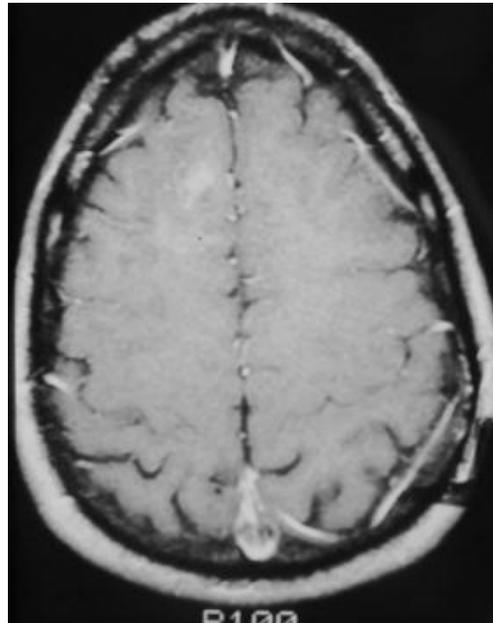
- ❧ Tumores dermoides-epidermoides

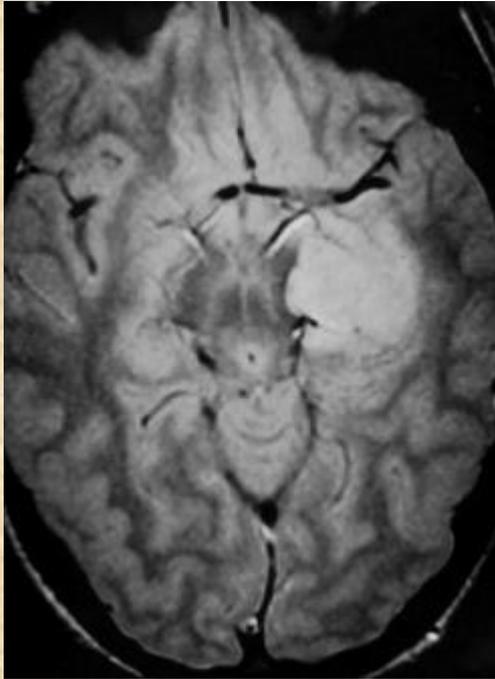
# TUMORES INTRAAXIALES SUPRATENTORIALES



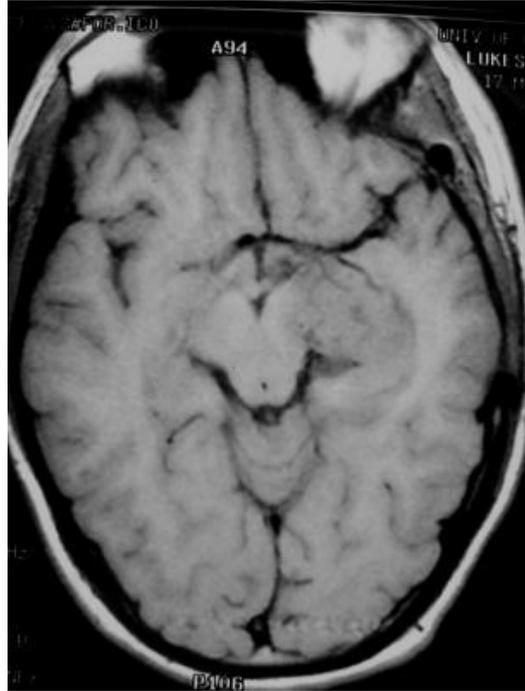
•TC

•T1 Gd

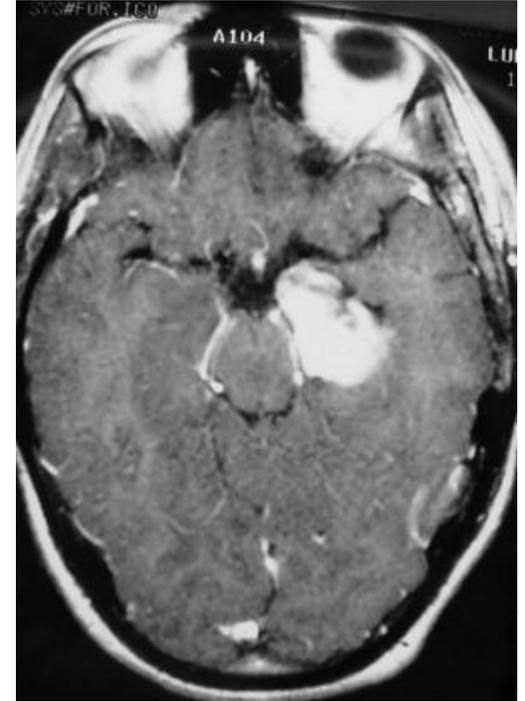




•T2

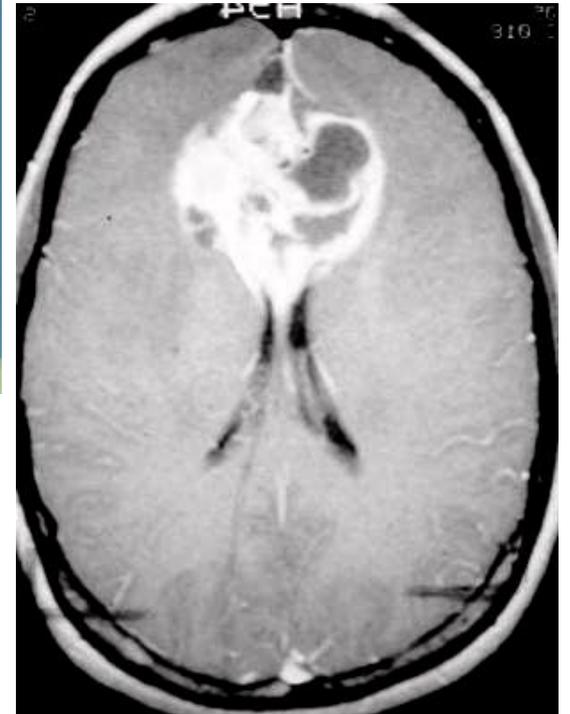
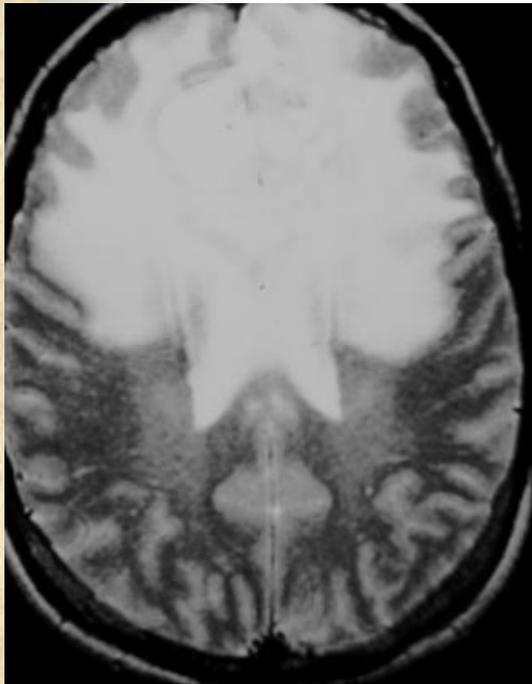


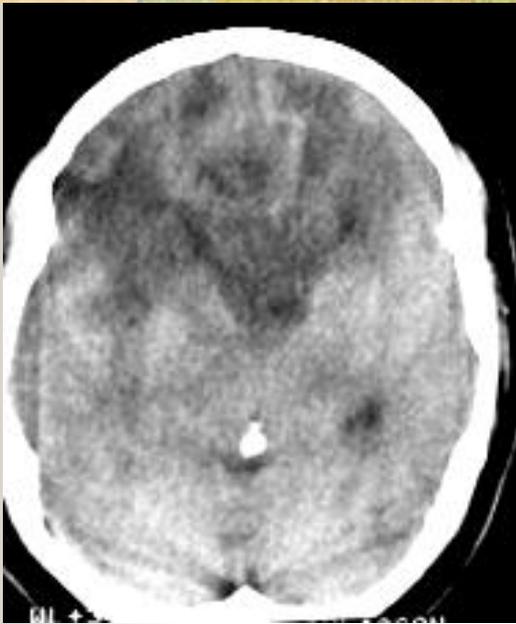
•T1



•T1 Gd

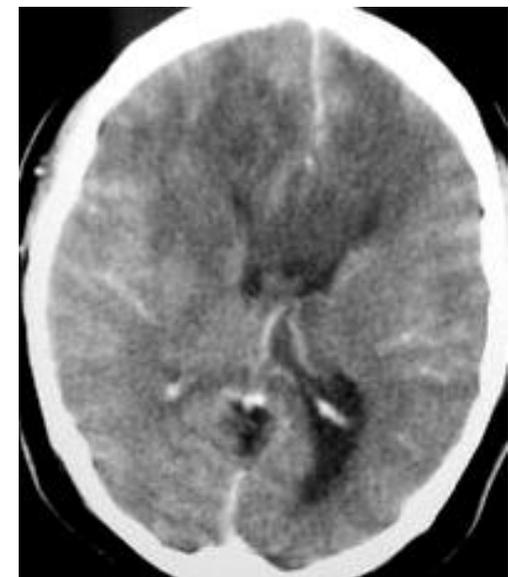
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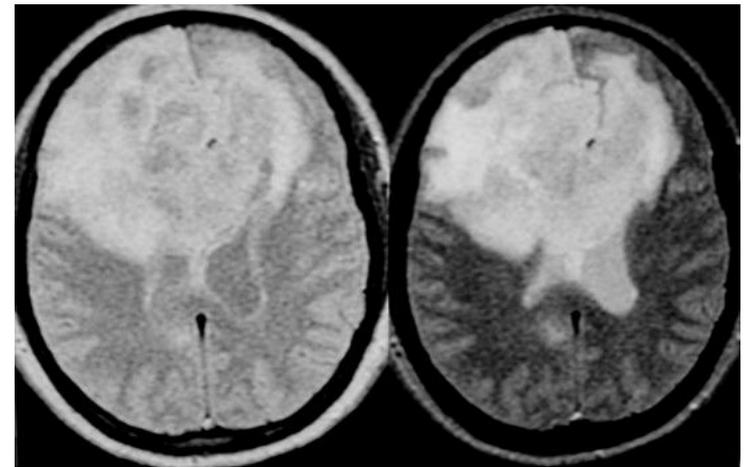
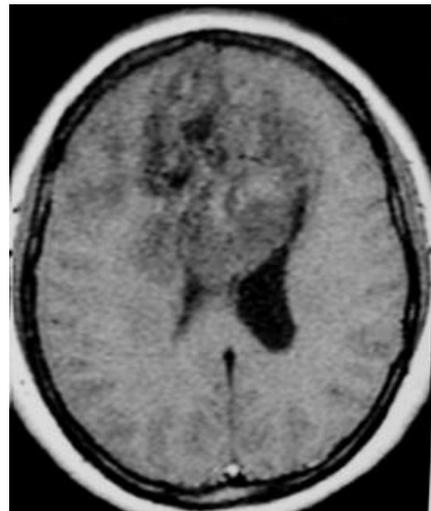
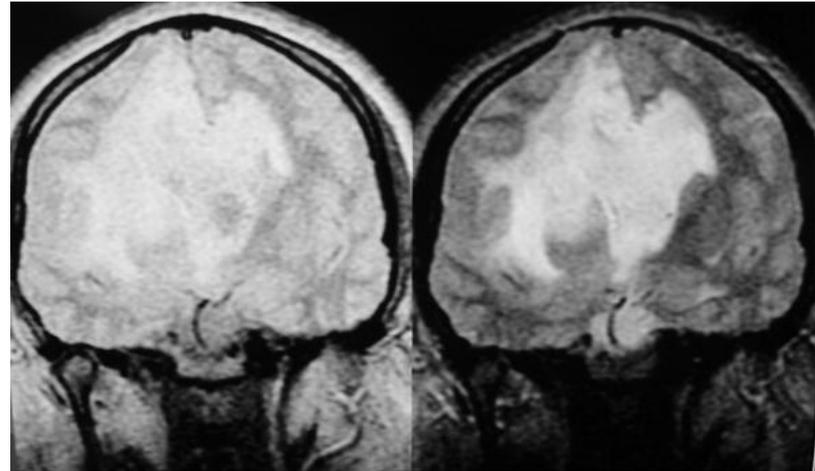
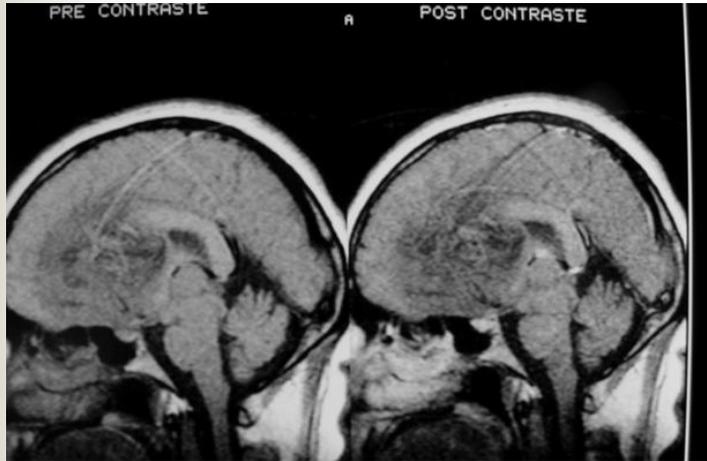


**TC simple**

**TC cte iv**

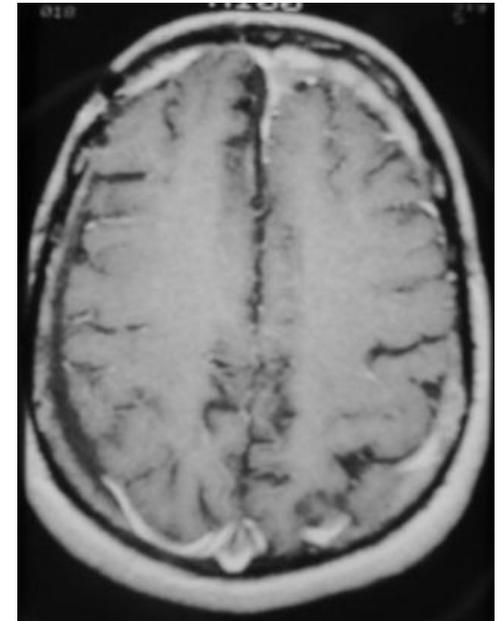
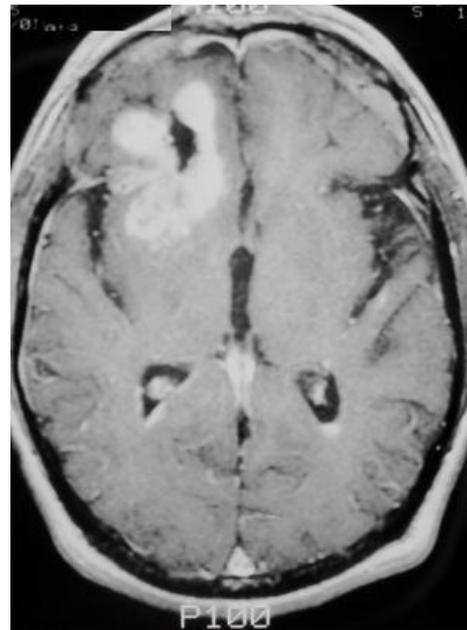
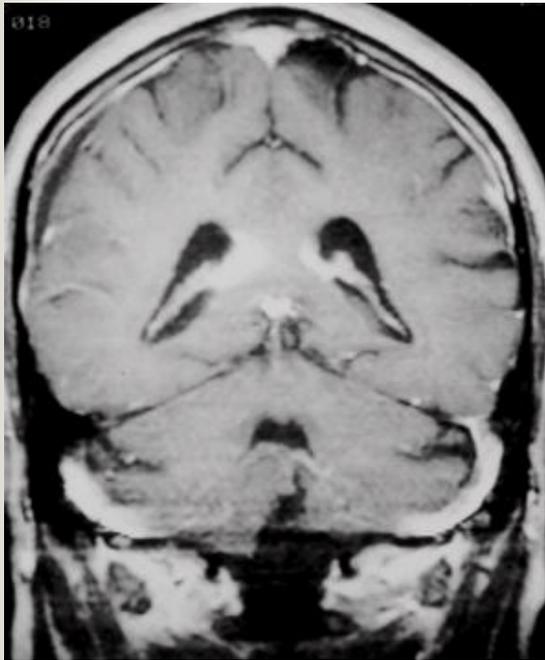


# GBM



# GBM

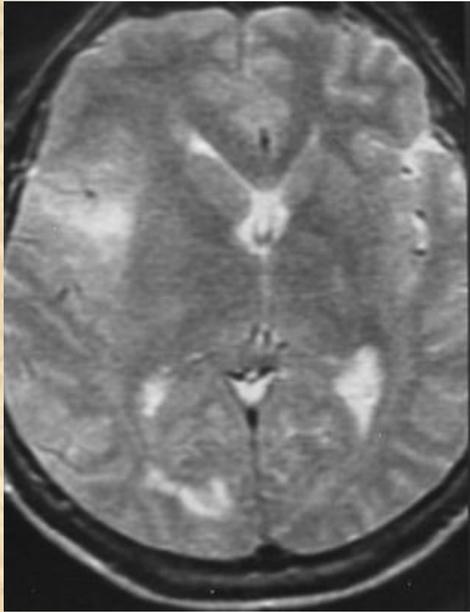
## EXTENSION TUMORAL



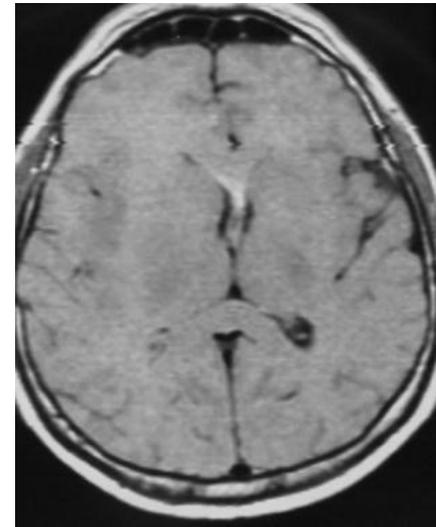
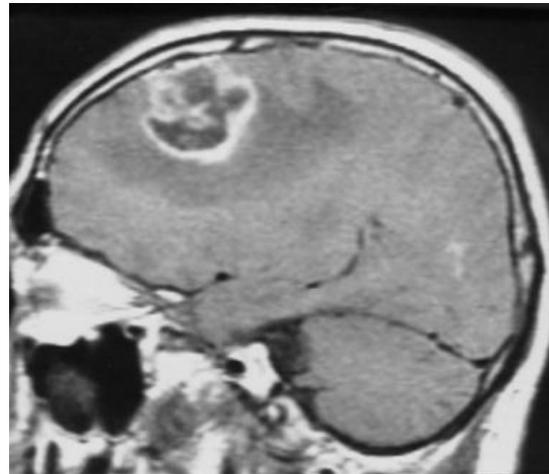
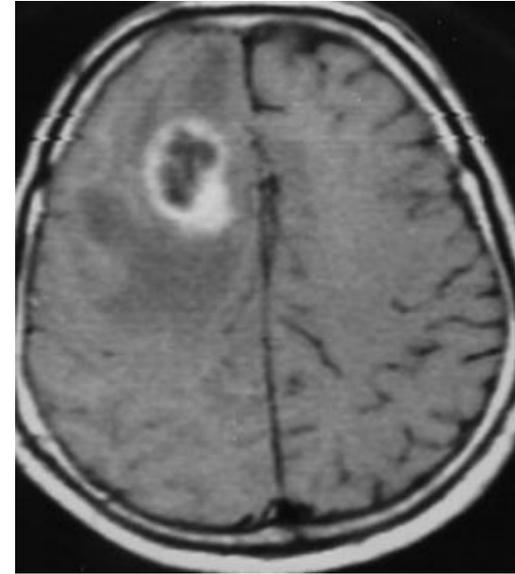
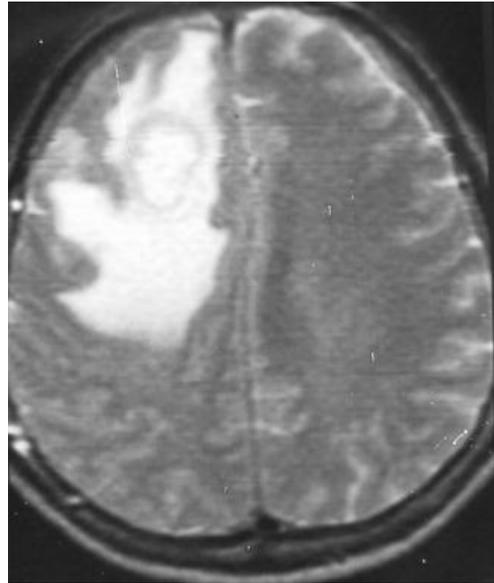
•Secuencias T1 Gd

# GBM EXTENSION TUMORAL

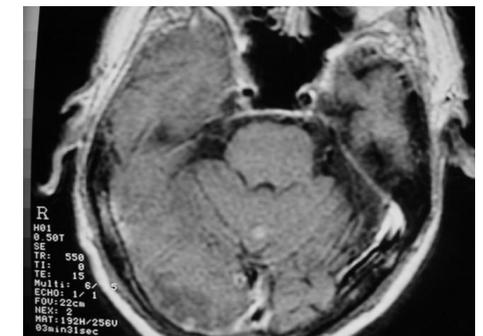
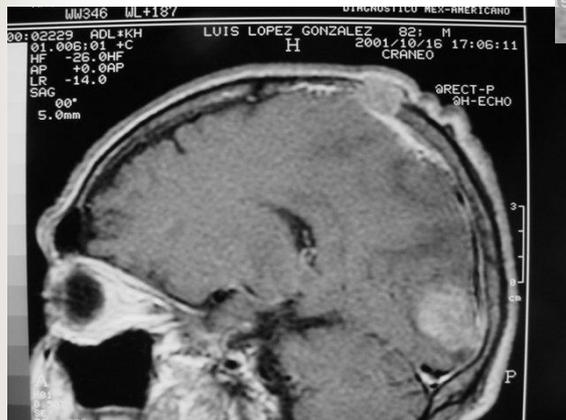
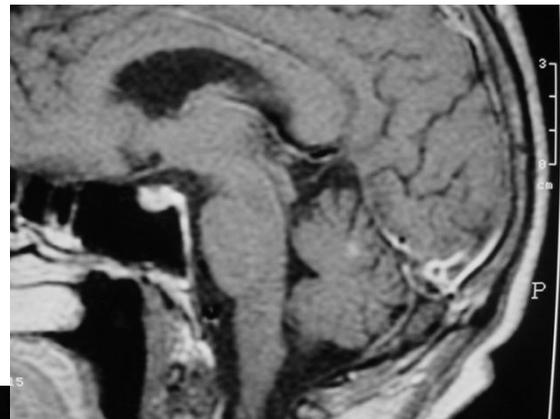
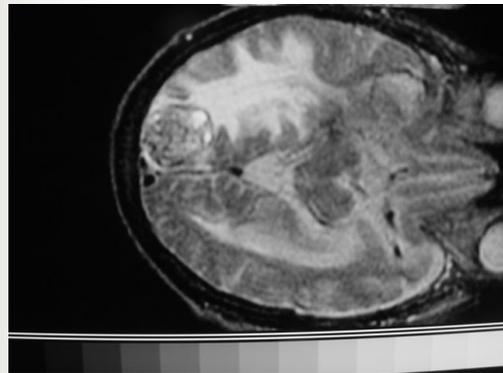
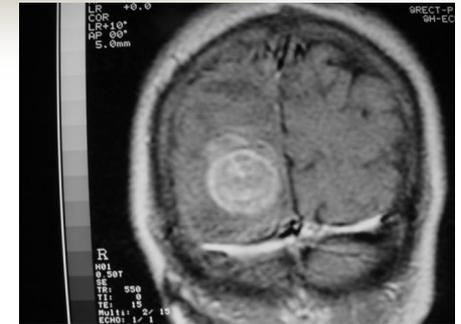
•T1 Gd



•T2



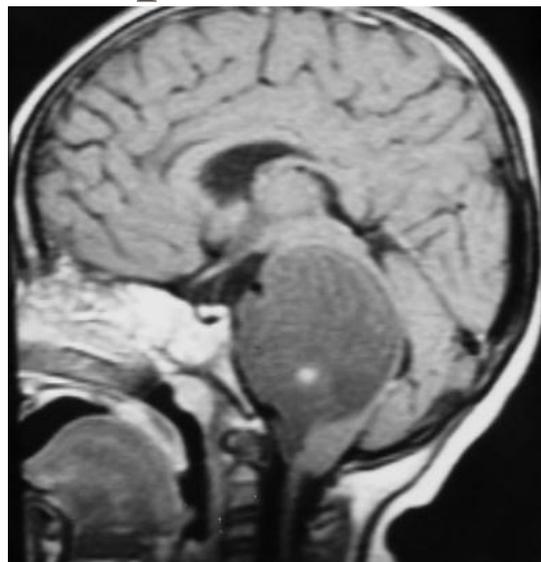
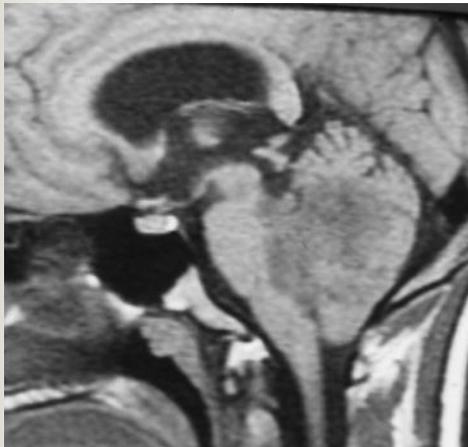
# METÁSTASIS



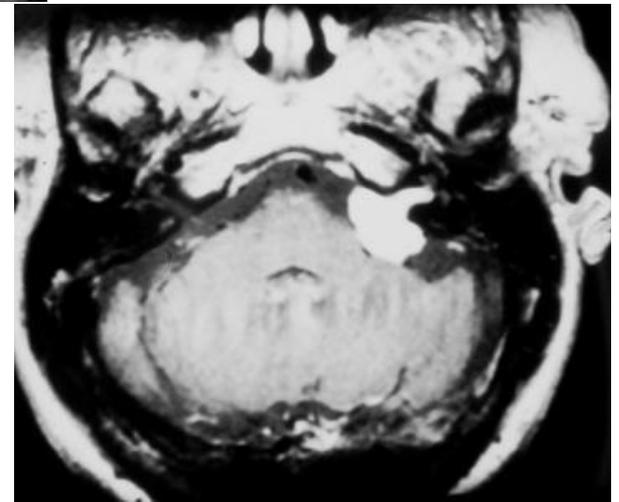
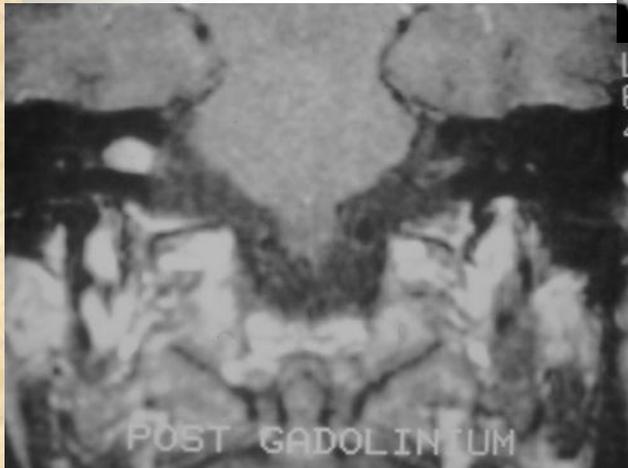
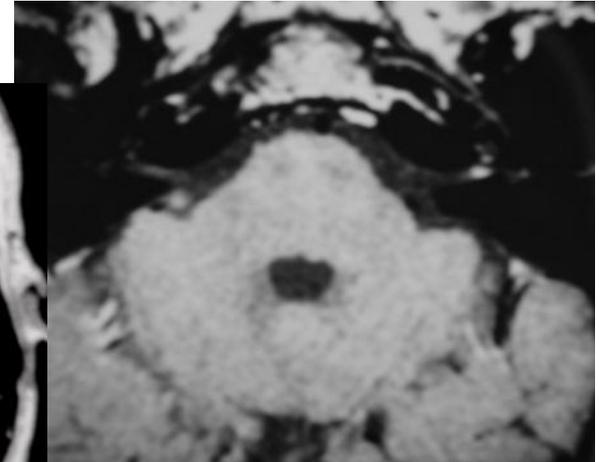
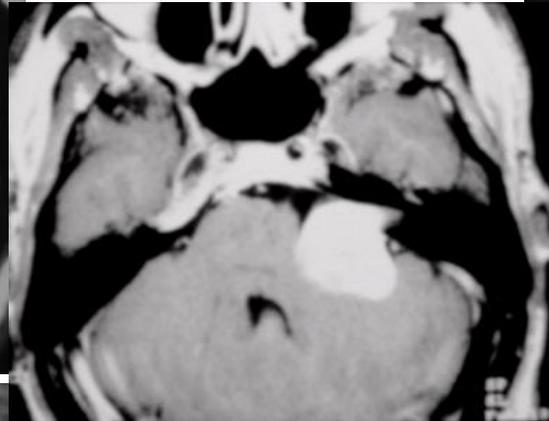
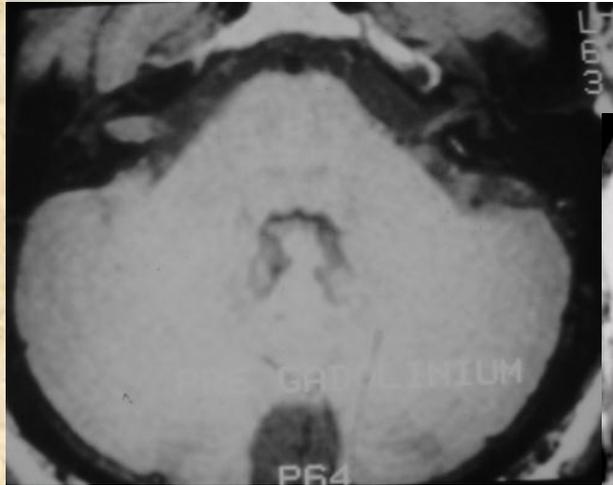
# NEOPLASIAS INTRACRANEALES

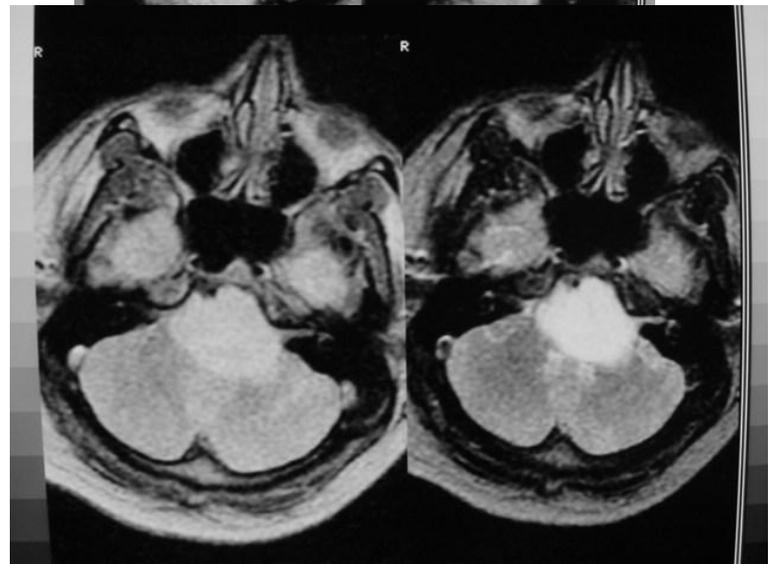
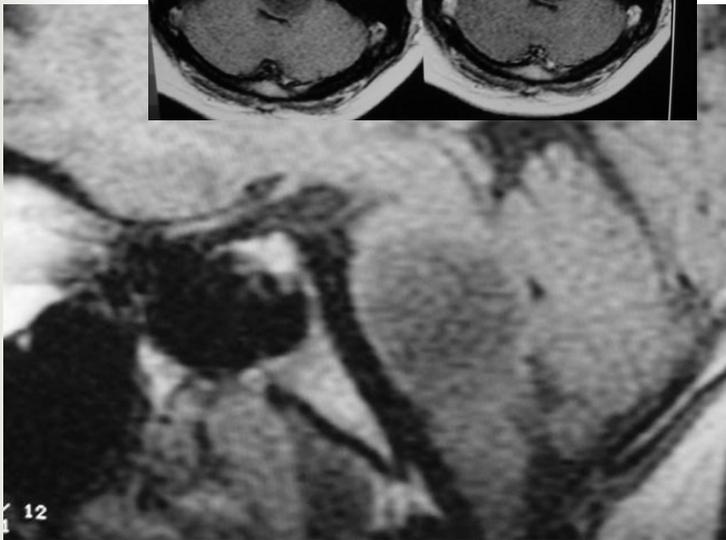
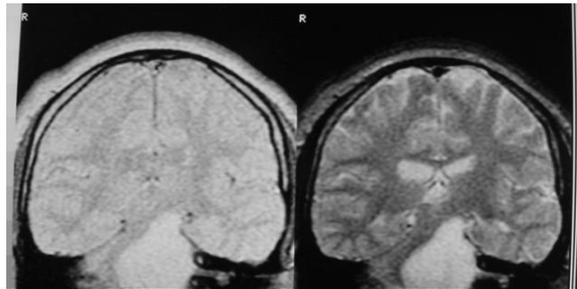
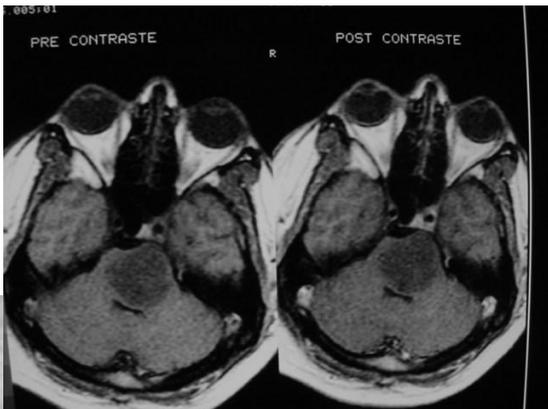
## ⌘ FOSA POSTERIOR

- ⌘ Meduloblastoma (PNET)
- ⌘ Ependimoma
- ⌘ Astrocitoma pilocítico



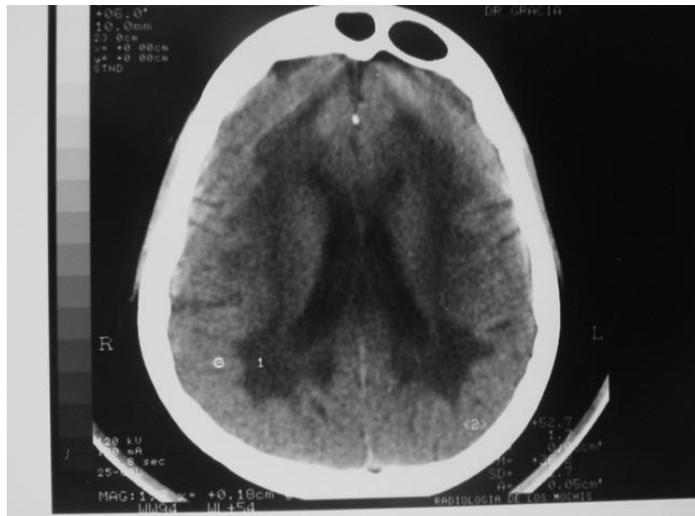
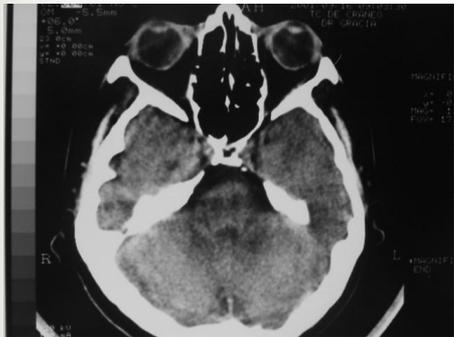
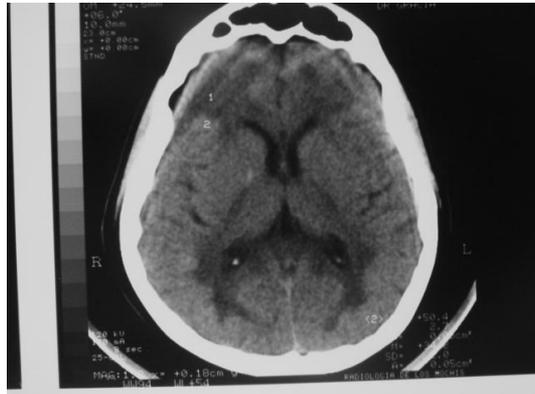
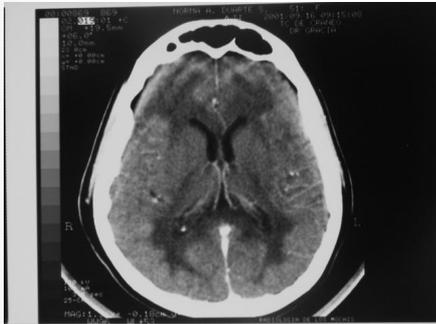
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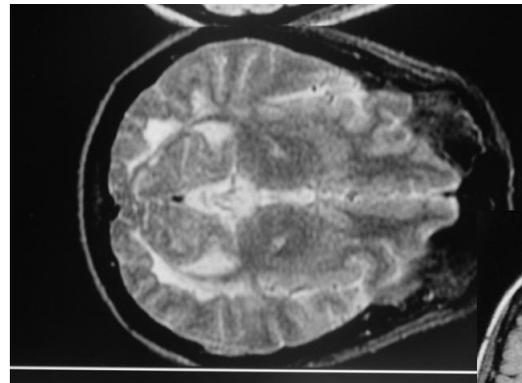
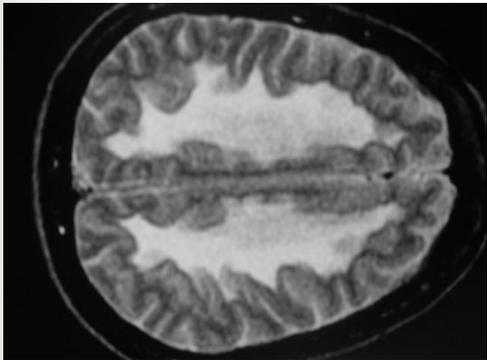
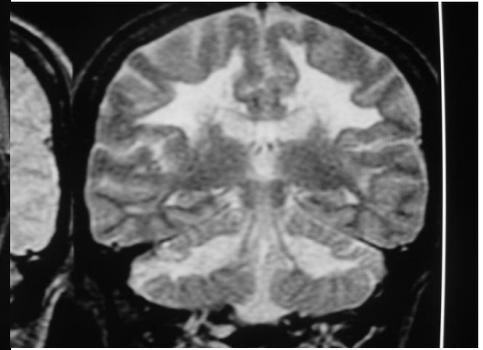
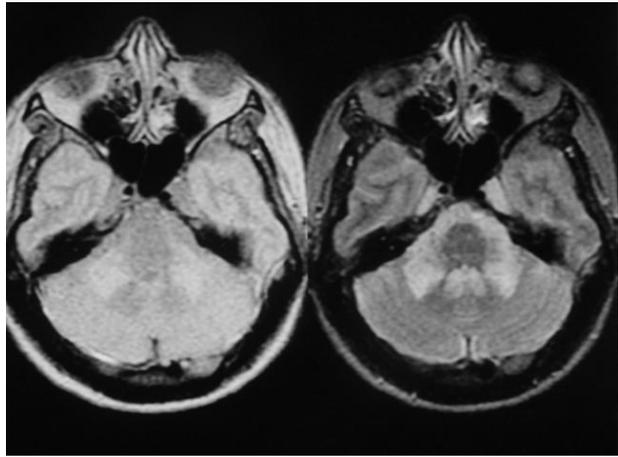
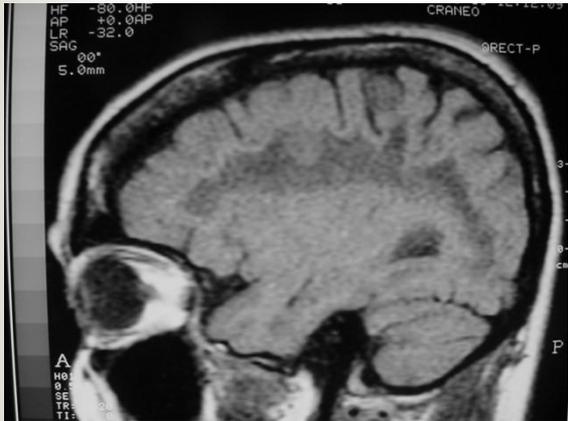




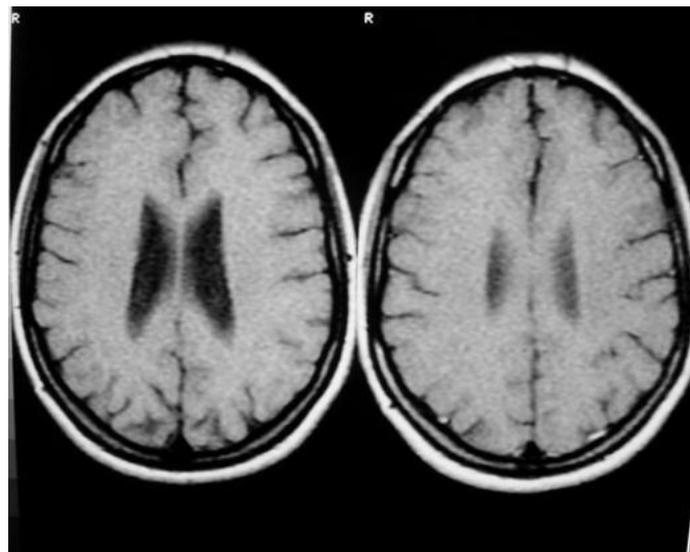
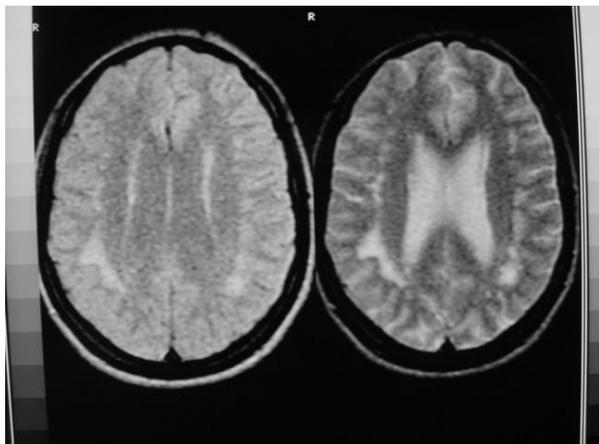
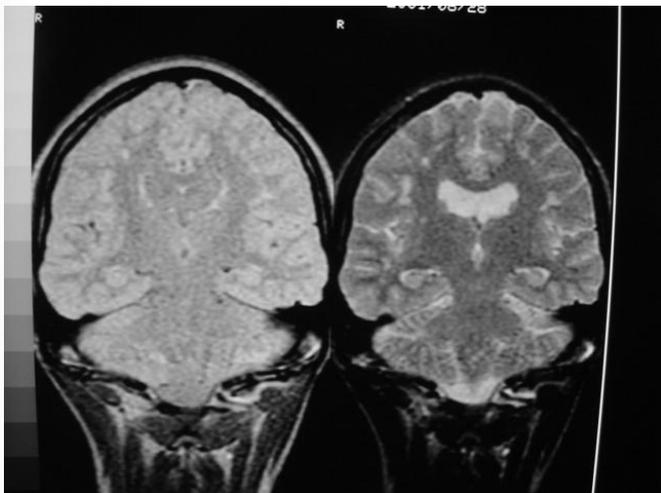


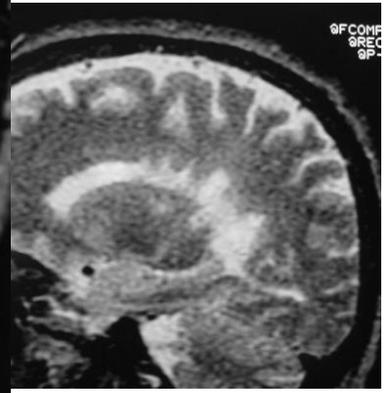
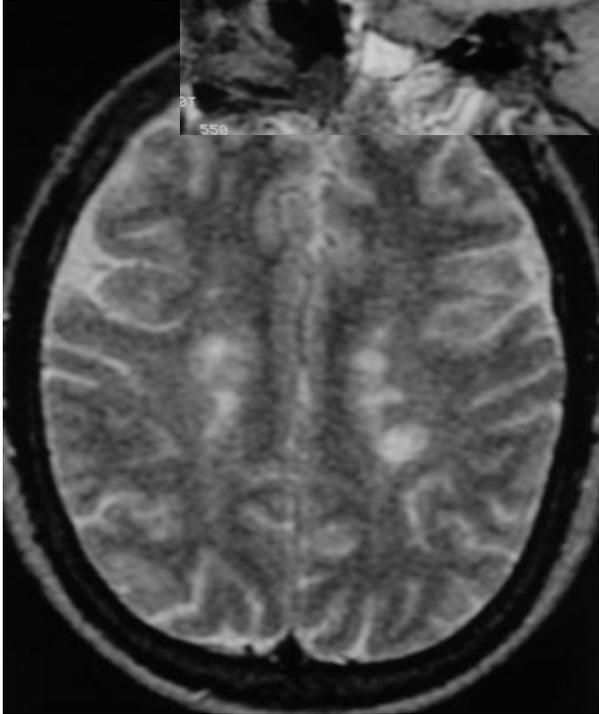
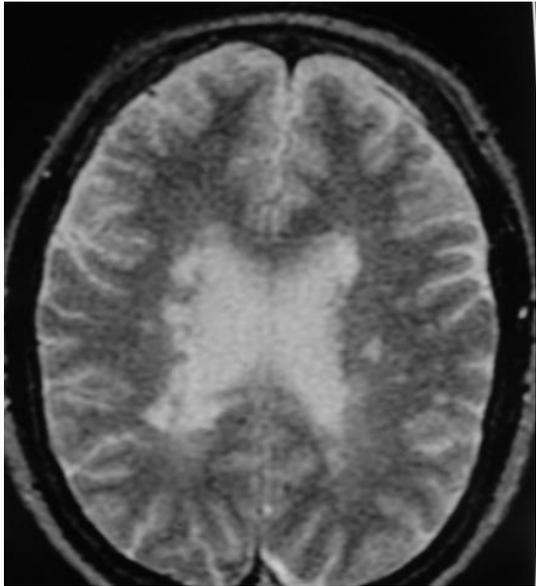
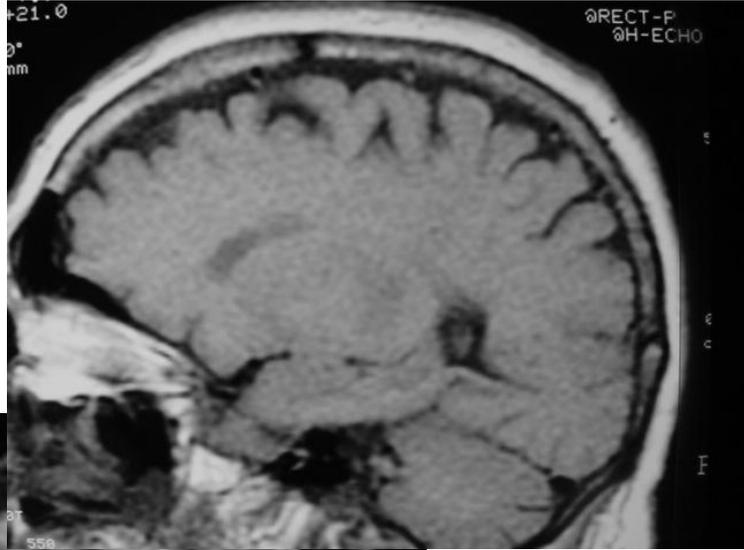
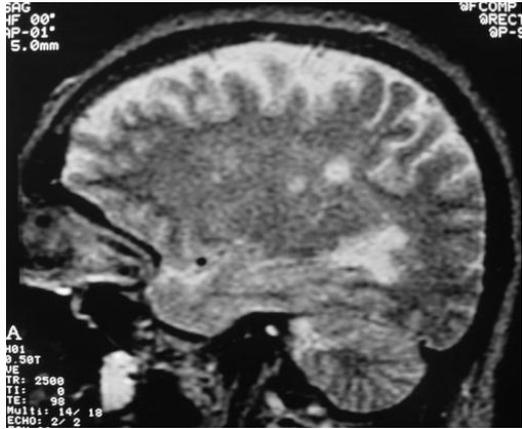
# **DEFICIT NEUROLOGICO PROGRESIVO**





# ESCLEROSIS MULTIPLE







**¶ Las crisis convulsivas deberán distinguirse de otras formas de alteraciones episódicas noepilépticas con EEG normal (espasmo del sollozo, síncope, migraña, alteraciones del sueño, movimientos anormales) que no requieren de evaluación rutinaria por neuroimagen , a menos que:**

- ¶ EEG anormal**
- ¶ Historia de alteración en el SNC**
- ¶ Trauma**
- ¶ Episodio hipóxico**

# CONCLUSION

La RM es el método de elección en estudio de la patología intracraneal, demostrando ventajas técnicas y diagnósticas

- ⌘ No radiación ionizante
- ⌘ Multiplanar
- ⌘ Caracterización tisular (edema, hemorragia, contenido proteico, etc.)
- ⌘ No artefacto óseo. Fosa posterior.
- ⌘ Enf. Sustancia blanca
- ⌘ Alta sensibilidad y especificidad



# CONCLUSION

**La Tomografía Computada es la modalidad de imagen diagnóstica inicial en:**

- ⌘ Déficit neurológico agudo (EVC)**
- ⌘ Cefalea aguda**
- ⌘ Trauma craneal agudo**
- ⌘ Detalle óseo**
- ⌘ Menor tiempo de estudio (paciente en estado crítico)**



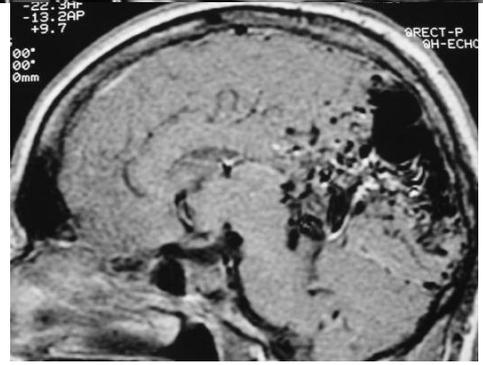
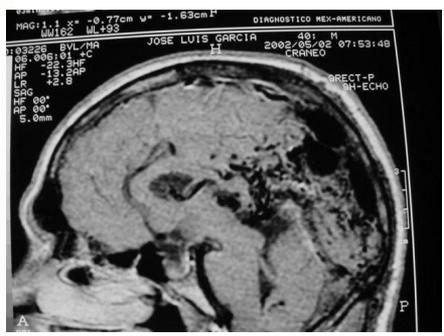
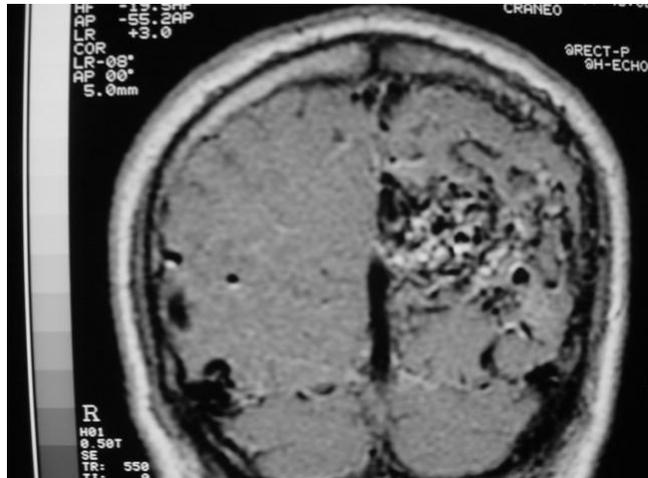
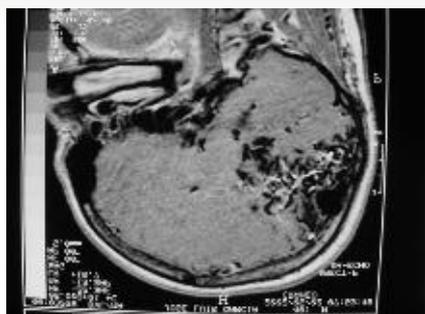
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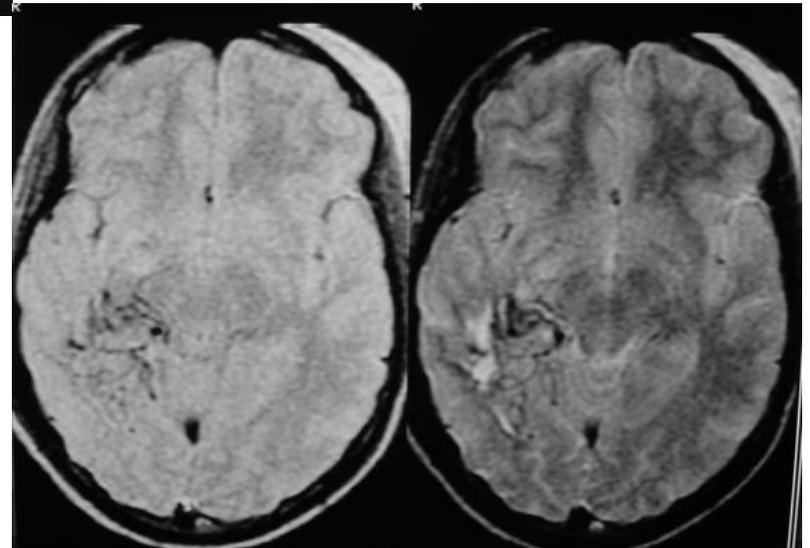
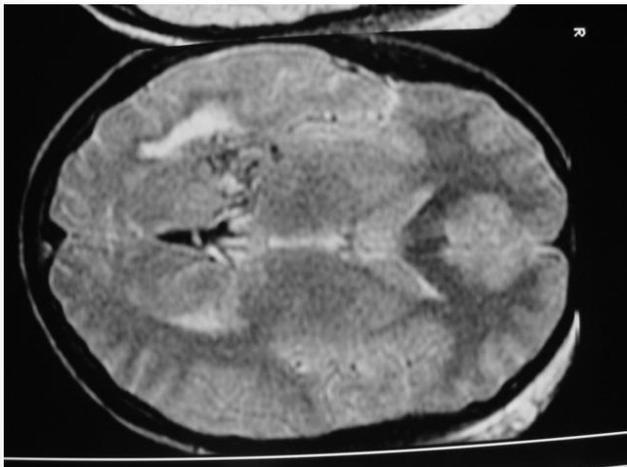
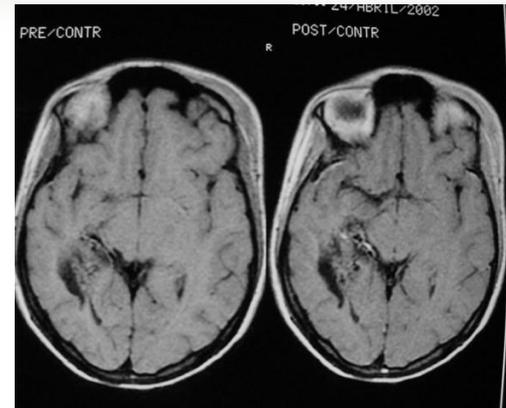
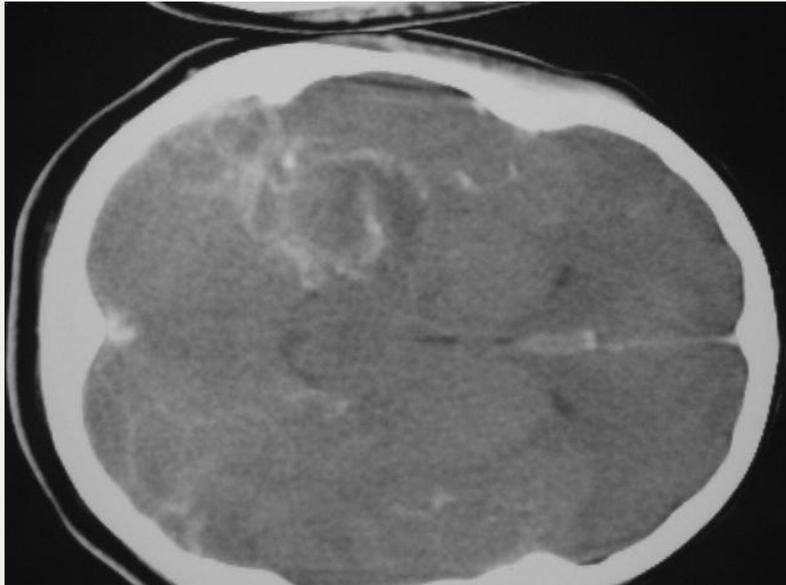


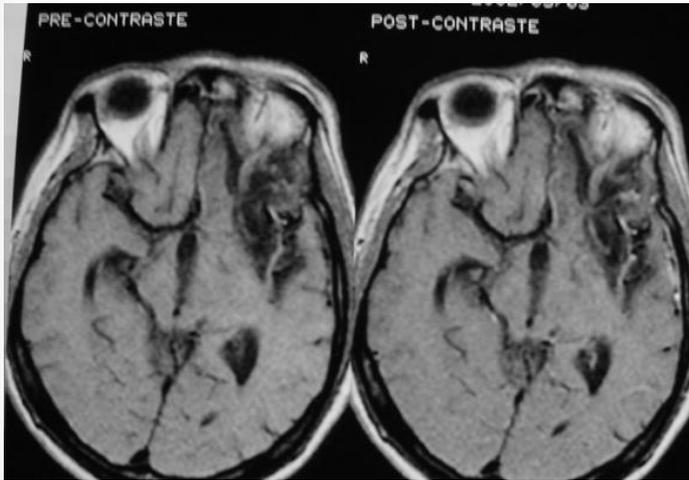
# INDICACIONES

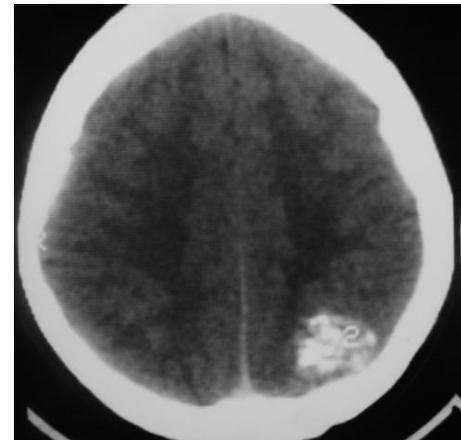
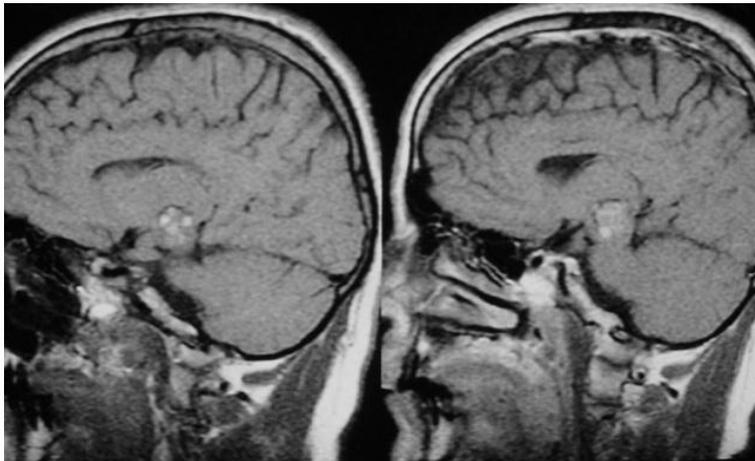
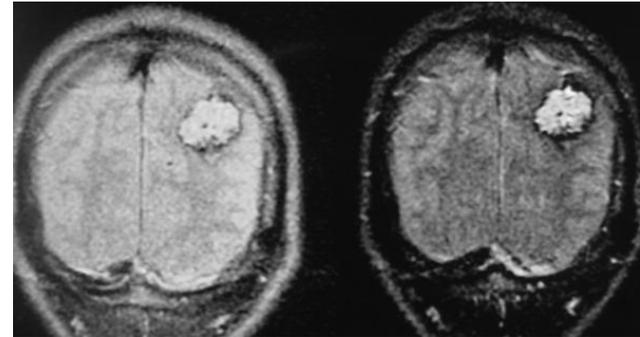
- ⌘ **Se recomienda en crisis convulsivas asociadas a:**
  - ⌘ **signos neurológicos anormales**
  - ⌘ **historia de alteración en el SNC**
  - ⌘ **focalización clínica o por EEG**
  - ⌘ **cambio en el patrón de la crisis o del EEG**
  - ⌘ **deterioro en el desempeño escolar**
- ⌘ **No son rutinariamente recomendados en la evaluación inicial del síndrome convulsivo benigno (ausencia, cc febriles).**

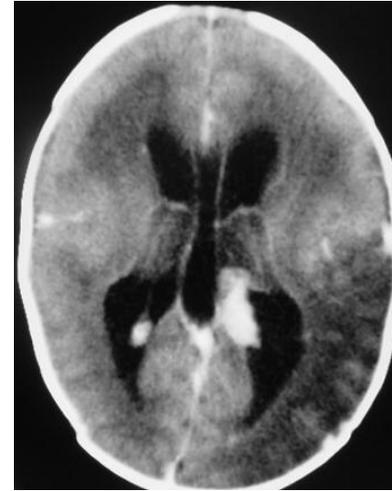
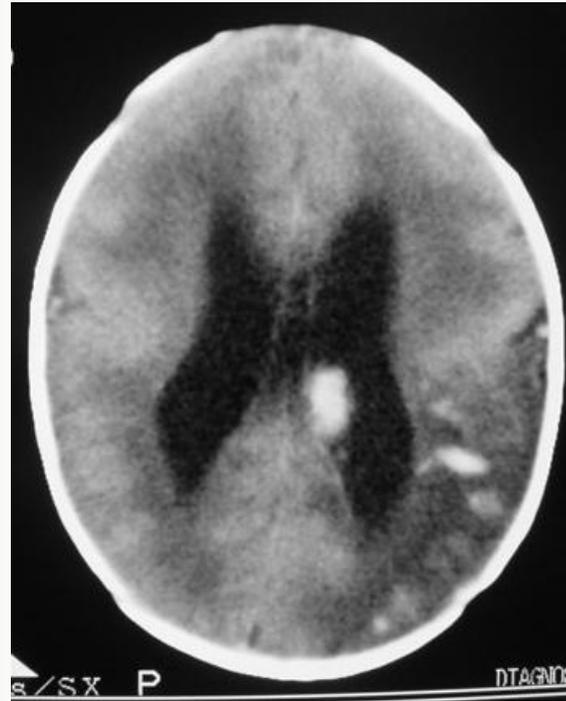
- 
- ⌘ **Aun con estudios de imagen iniciales negativos, deberá realizarse seguimiento o reevaluarse por imagen si ocurre:**
    - ⌘ **Cambio en la exploración neurológica**
    - ⌘ **Cambio en el patrón de la crisis convulsiva**
    - ⌘ **Cambio en el EEG**

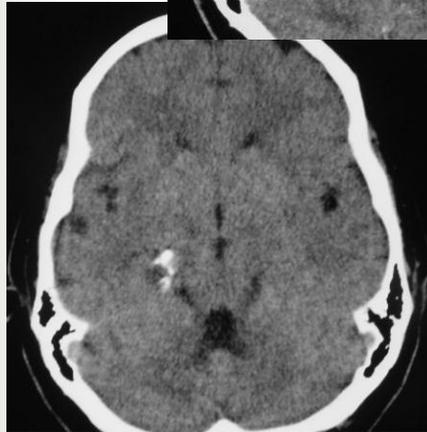
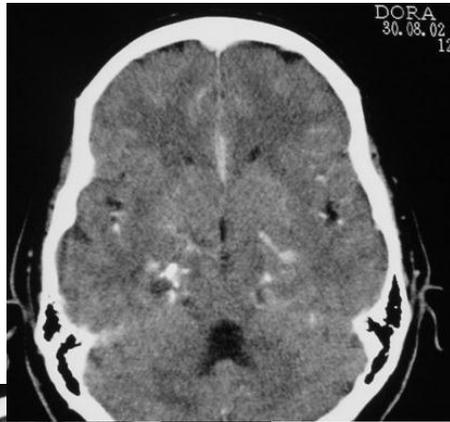


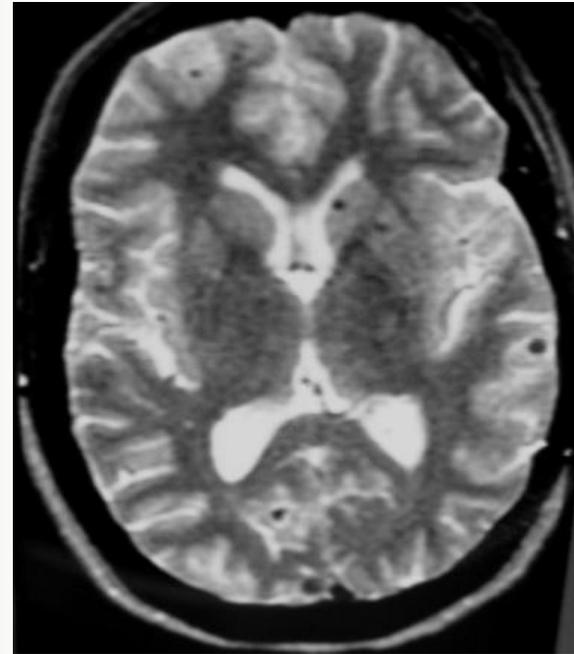


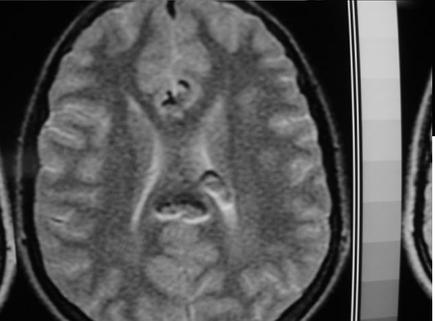
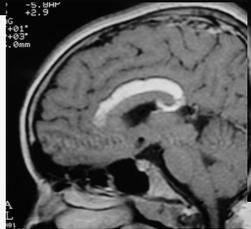
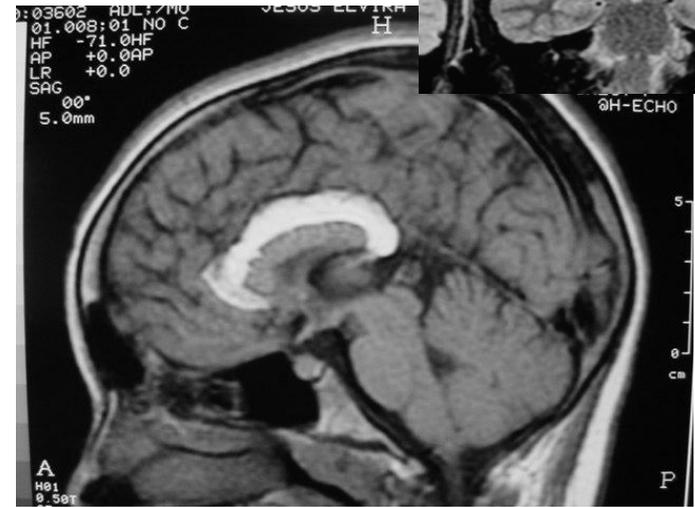
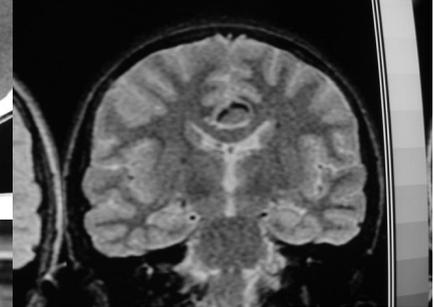
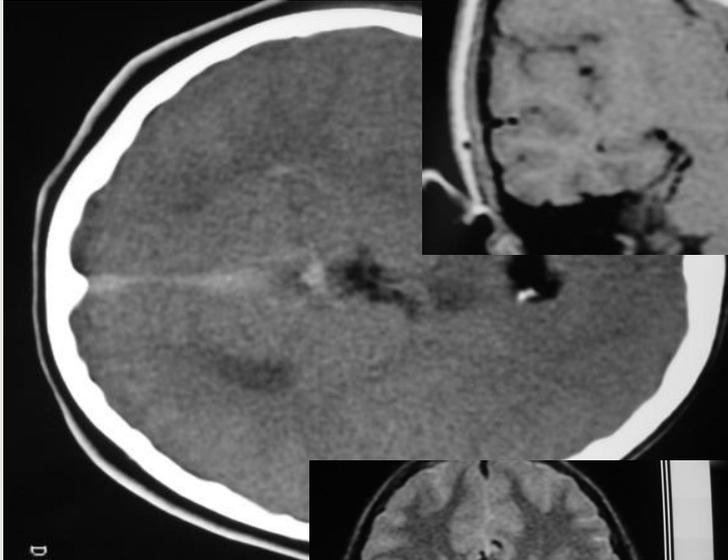
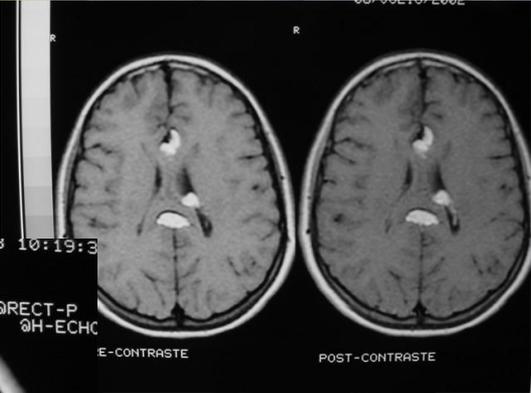
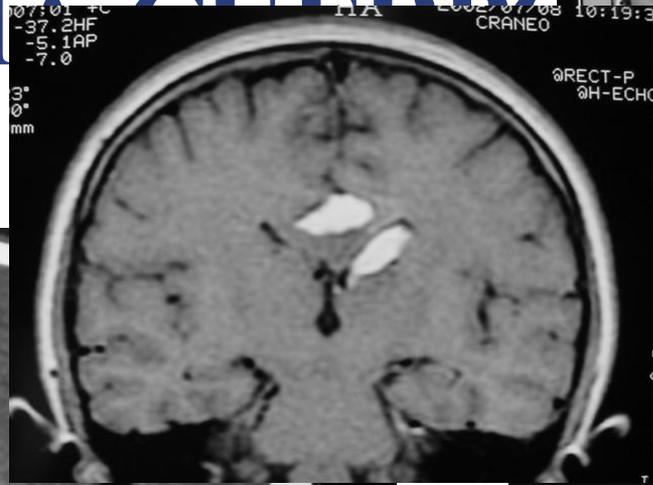
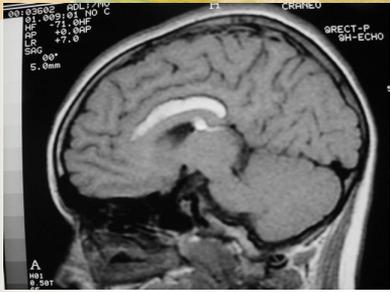




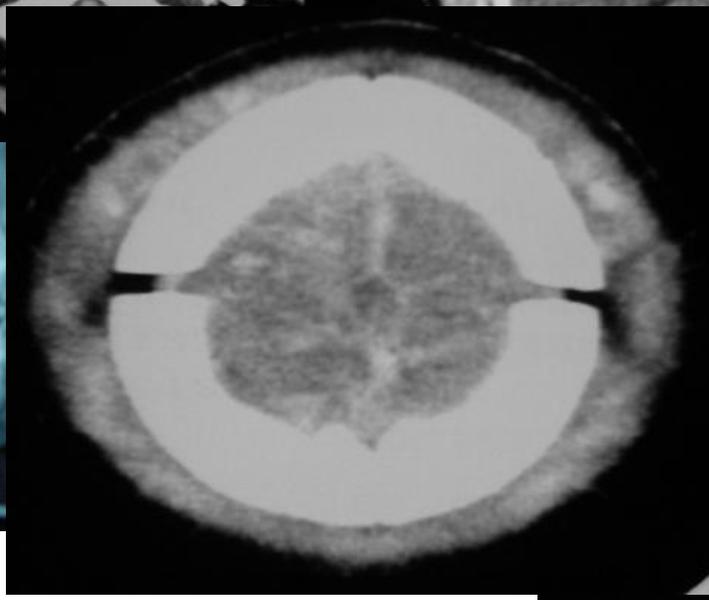
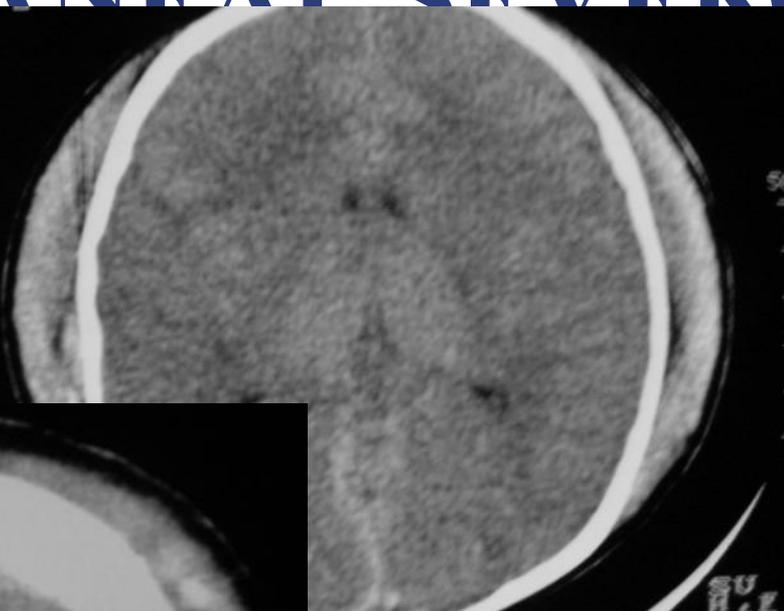
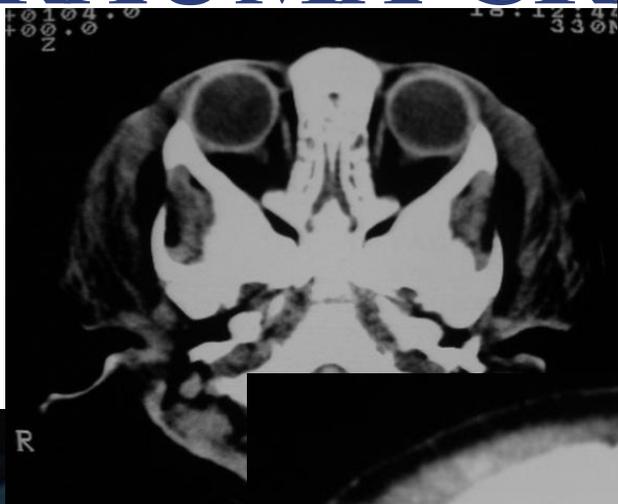




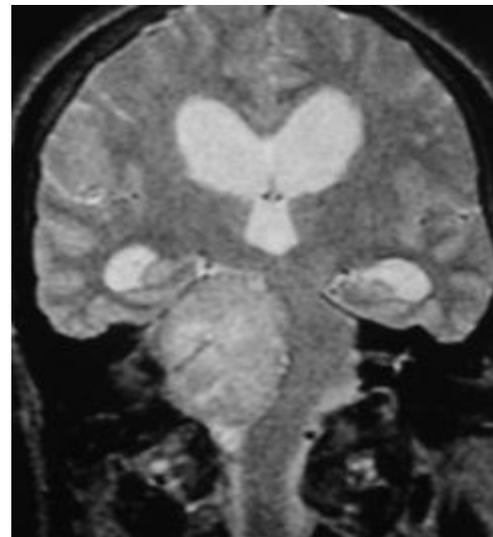
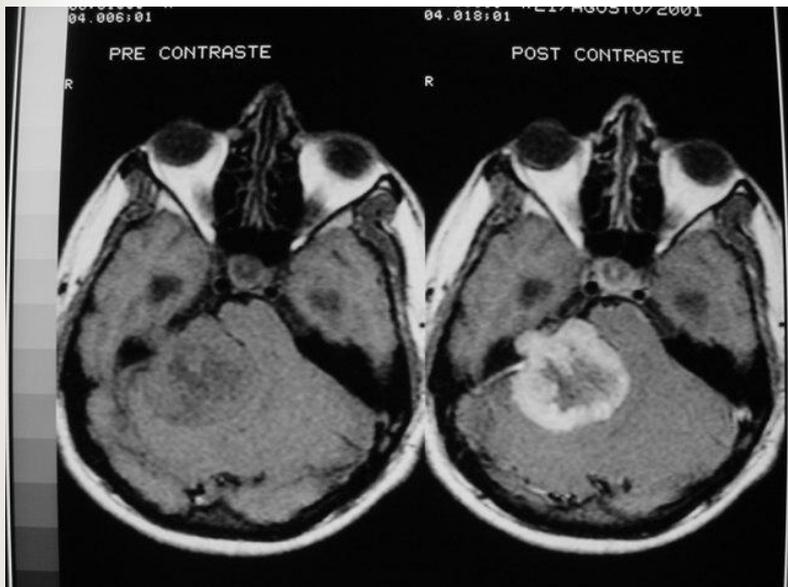




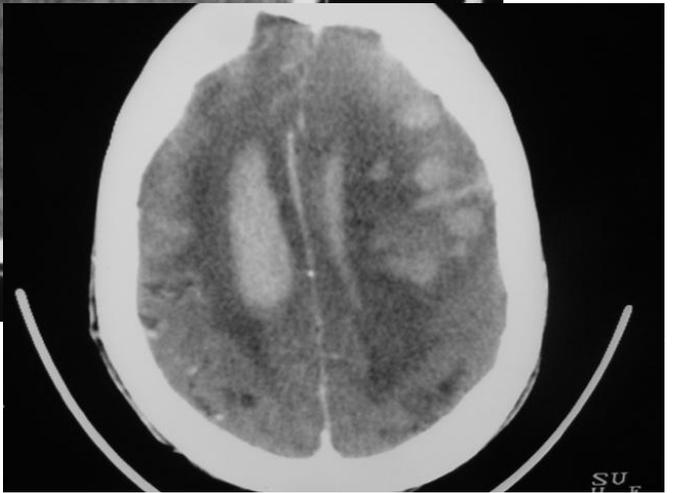
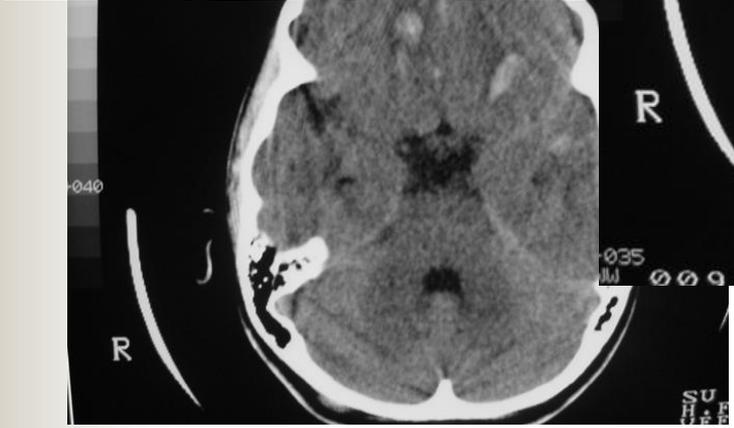
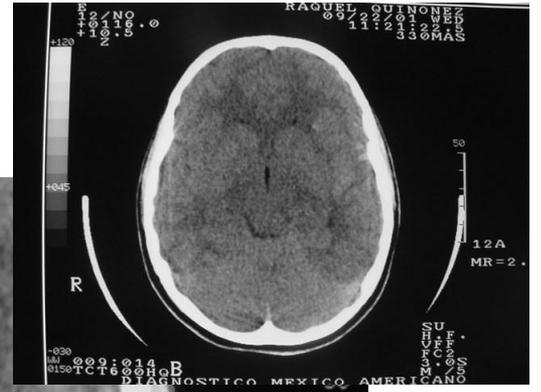
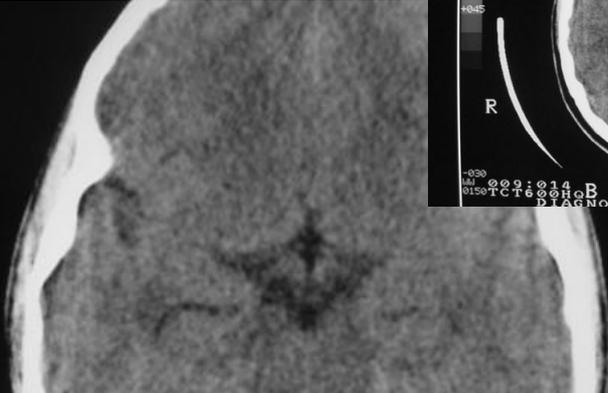
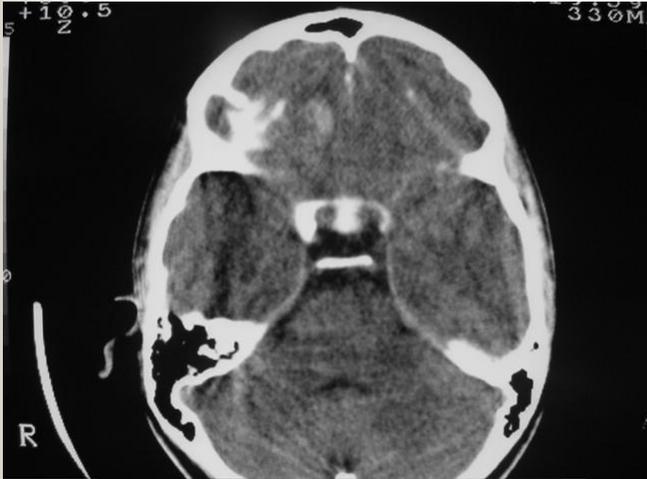
# TRAUMA CRANIAL SEVERO



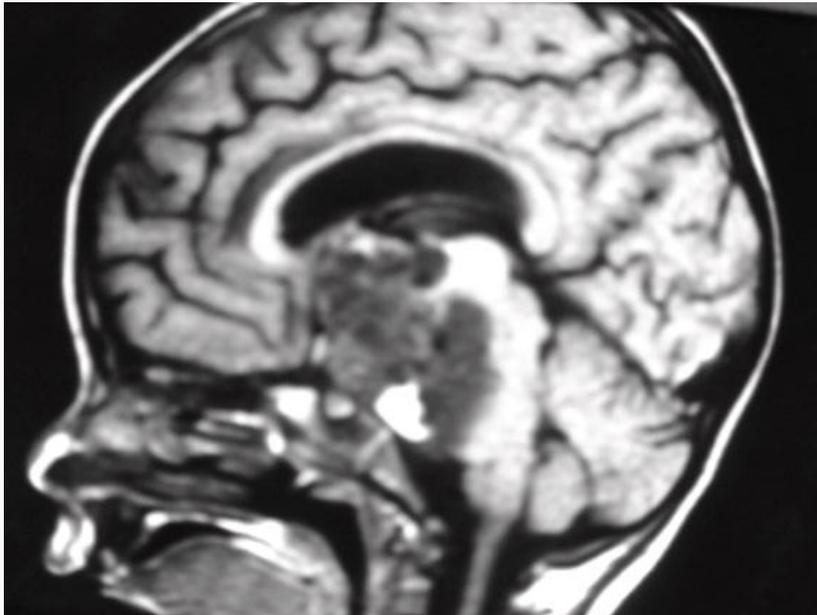
# SCHWANOMA



# Trauma craneal severo



# craneofaringioma



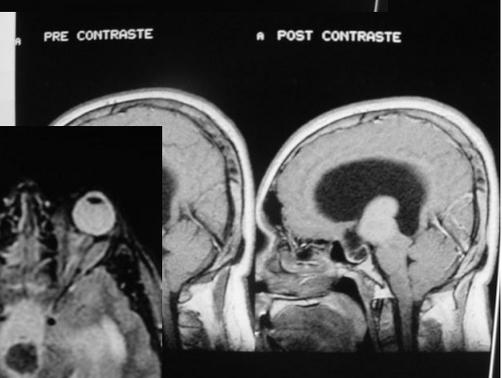
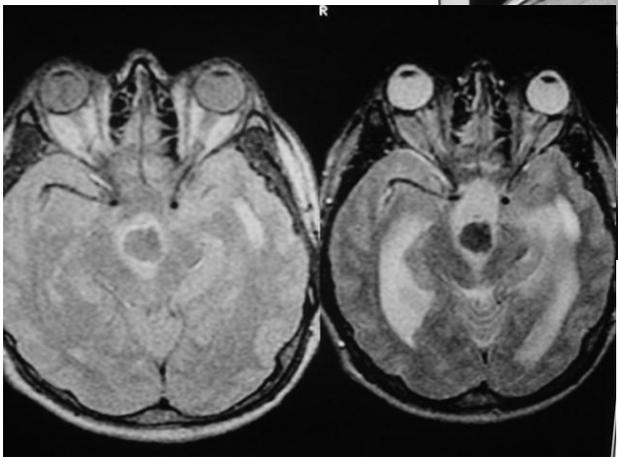
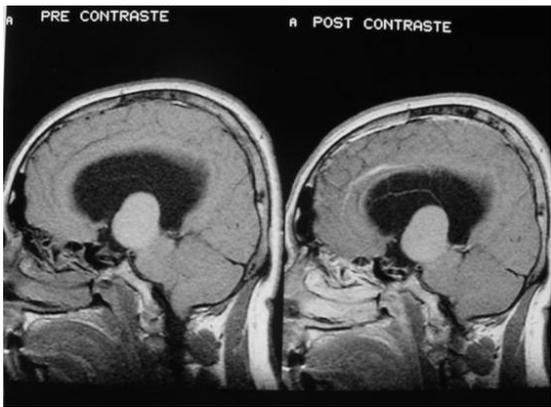
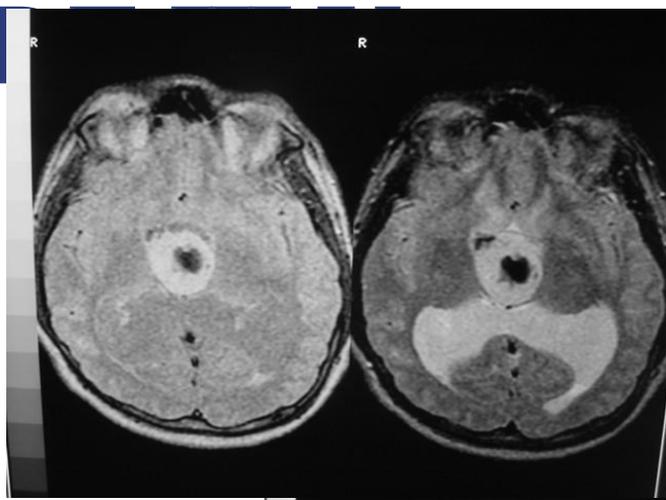
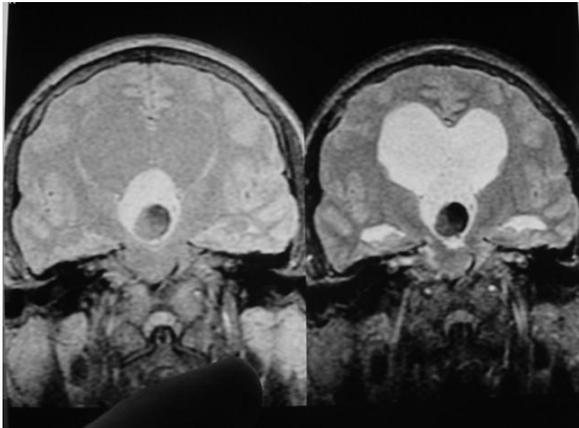




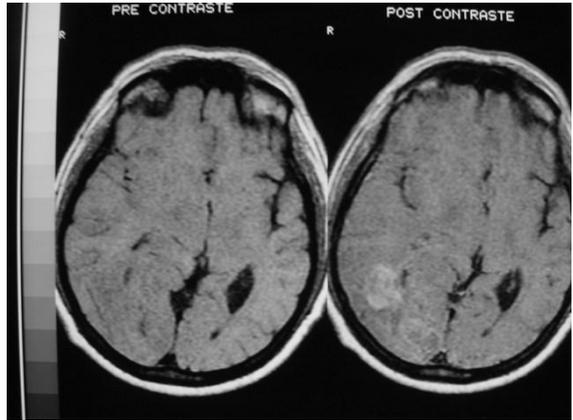
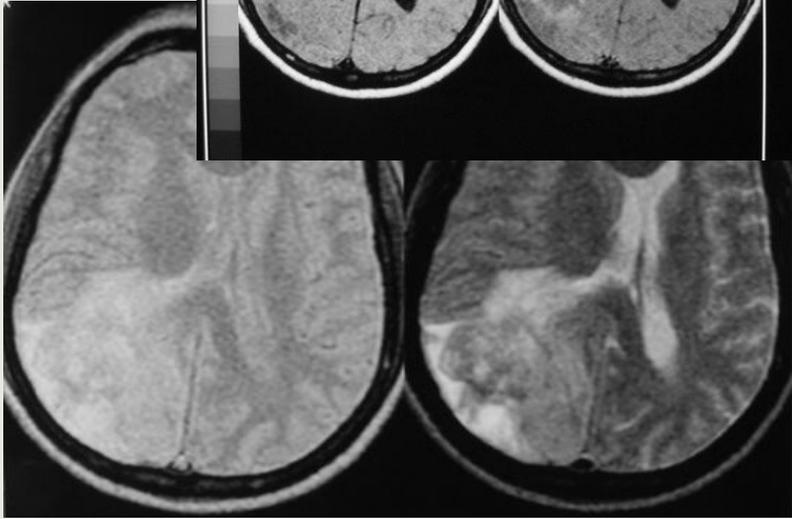
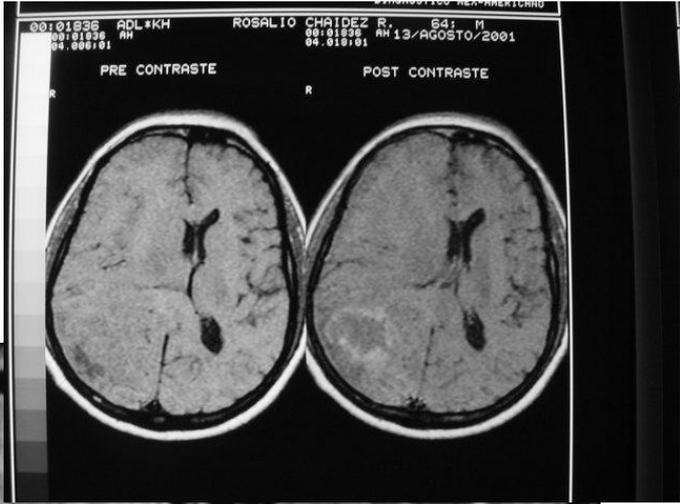
# ESTUDIOS DE IMAGEN

- ⌘ Evaluación de la causa de la crisis convulsiva
- ⌘ Efectos de la terapia anticonvulsiva
  - ⌘ Atrofia focal o difusa

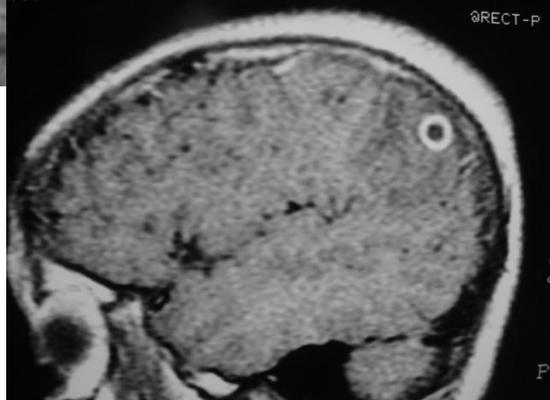
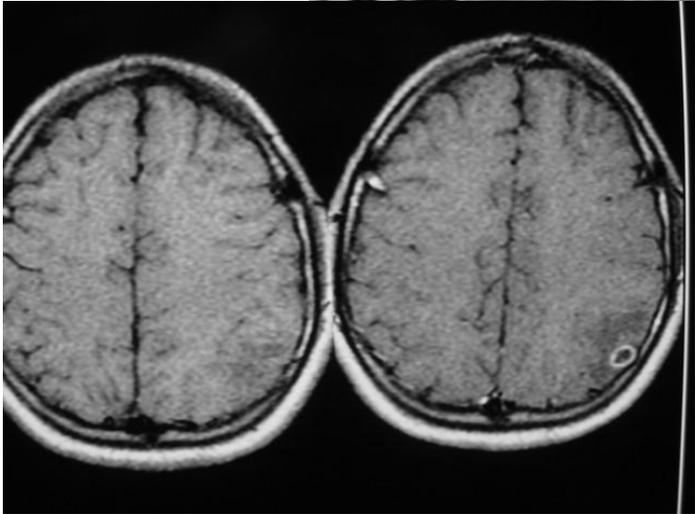
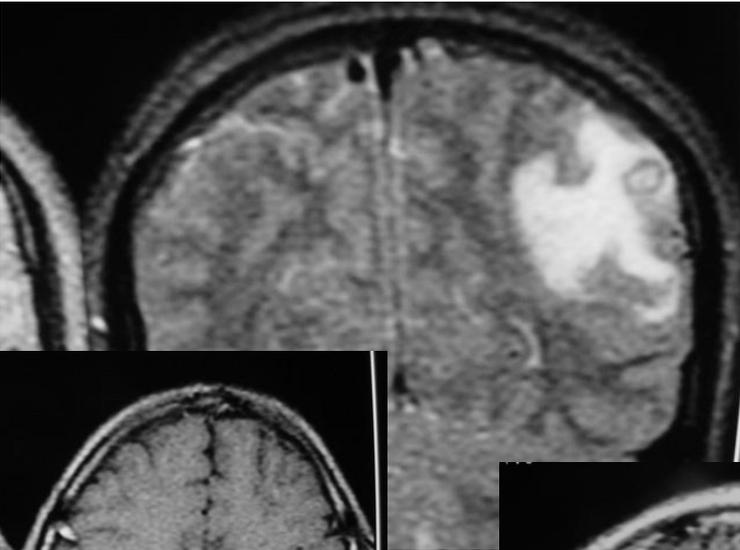
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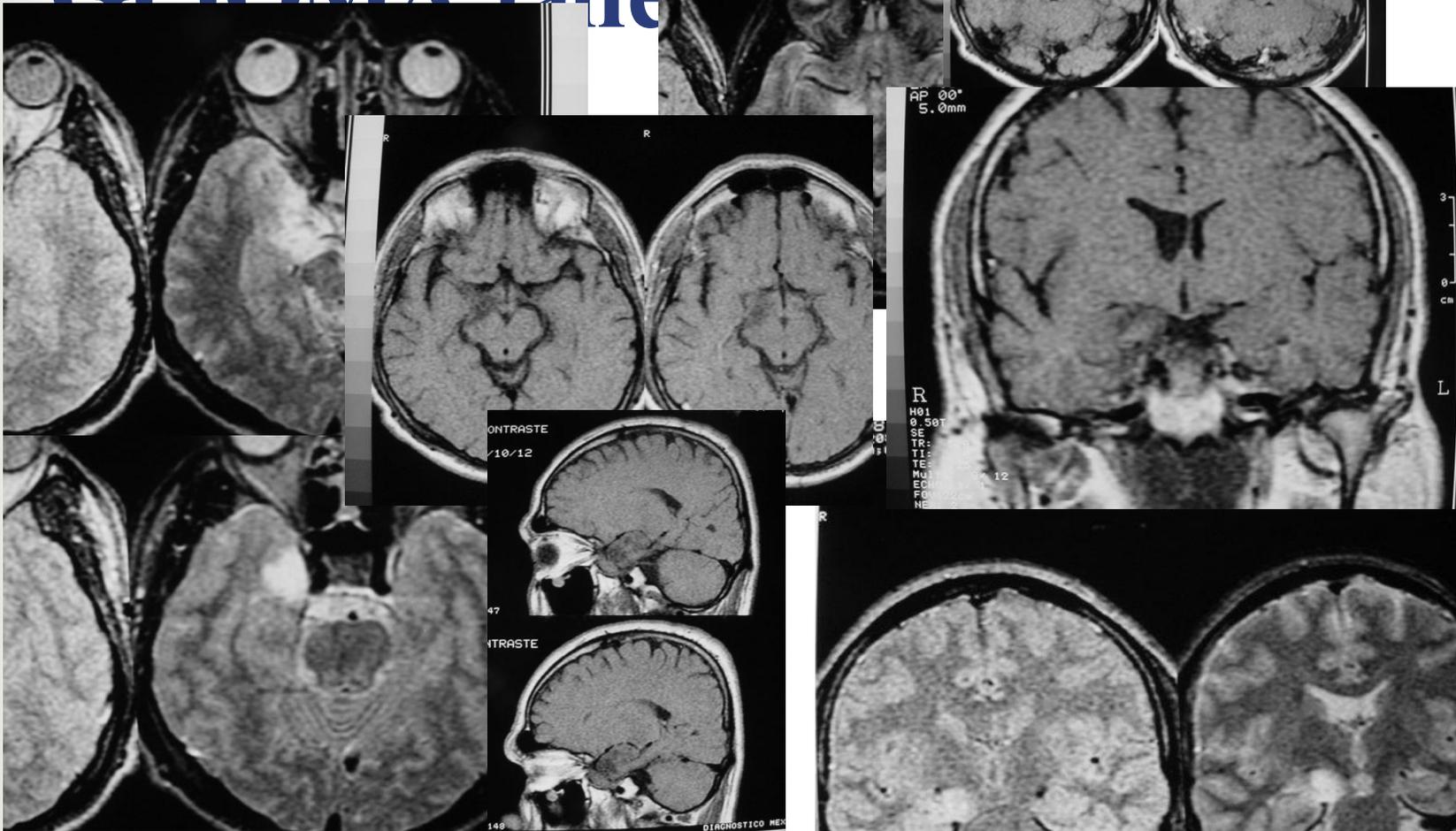
# GBM



# TALLER



# GLIOMA tallo



# MENINGIOMA PLANO ESFENOIDAL

